ILLUMINATING ENGINEERING

DECEMBER 1955

•

Street Lighting Papers

The General Secretary's Report

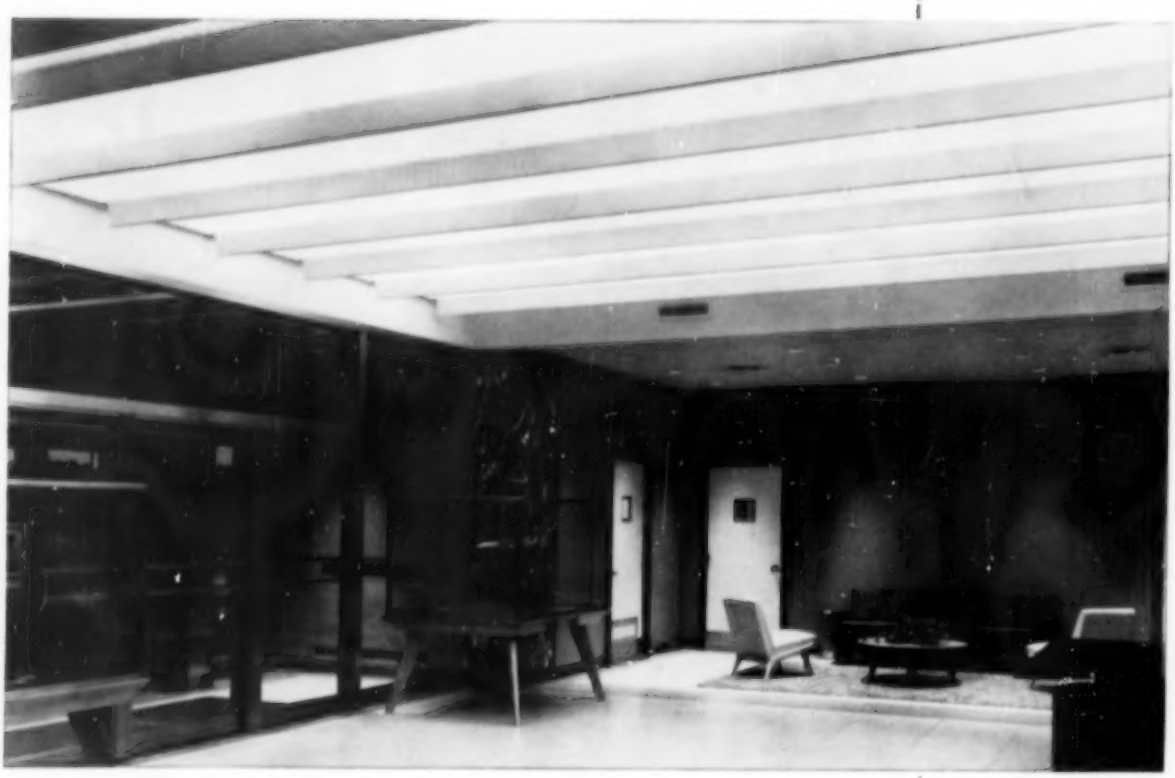
Lighting Applications

and I.E.S. Committee Personnel

THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

WAKEFIELD CEILING

Another Installation



A Wakefield Ceiling Greets Visitors to New Electronics Plant

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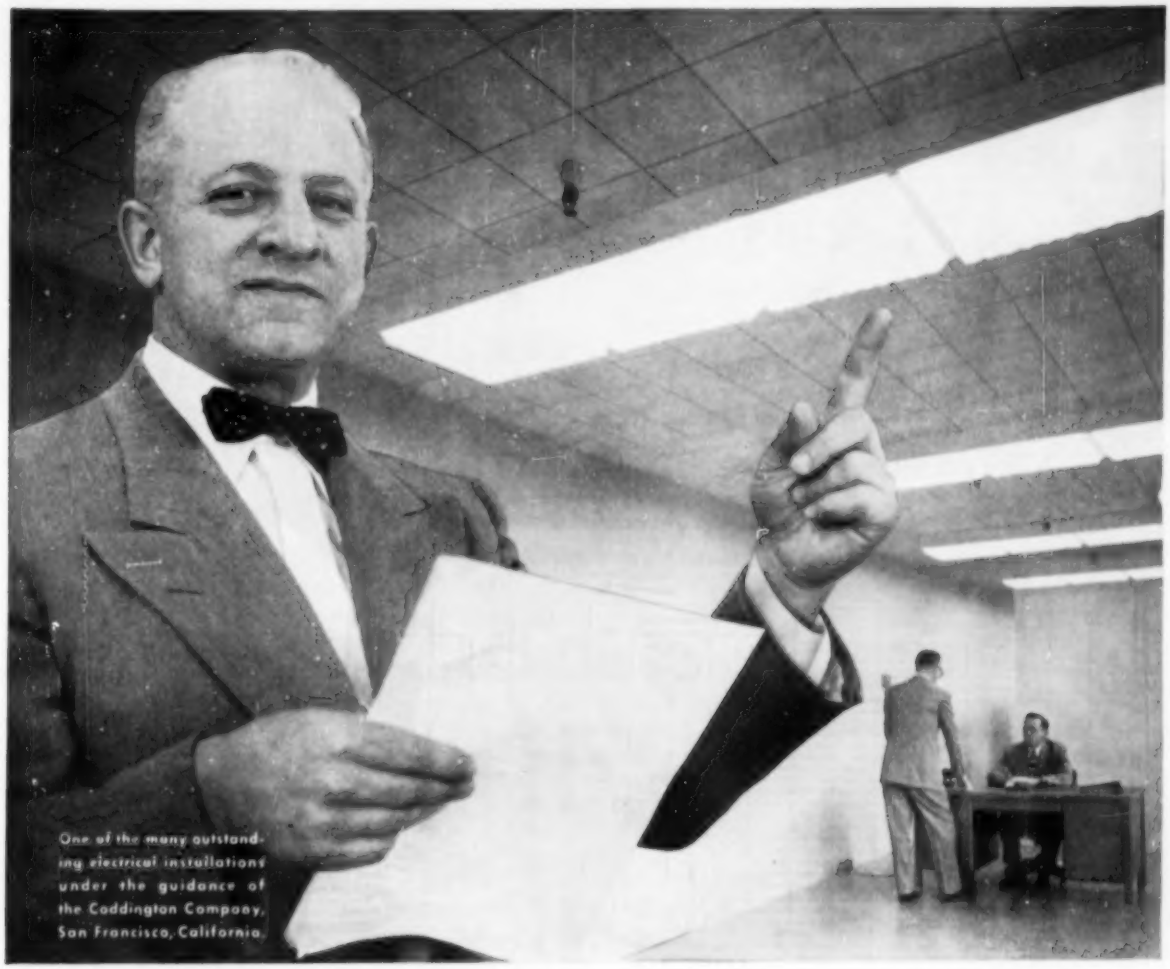

One of the many outstanding electrical installations under the guidance of the Coddington Company, San Francisco, California.

Prominent consulting engineer says . . .

"I always specify slimline *lead-lag* ballasts"

Mr. H. R. Gerber, well-known San Francisco consulting engineer, with broad experience as an electrical inspector and construction design engineer, gives these reasons why he specifies slimline *lead-lag* ballasts rather than the series type:

"It is still very inconvenient to have both lamps in the fixture inoperative if one fails when using series-sequence ballasts. Think of the additional time and energy used in removing both lamps and testing to find which lamp is burned out, or carrying a spare lamp on a ladder and trying to juggle the new lamp and remove the bad one. It requires a certain amount of strategy and additional time. In my opinion, in a few years this adds up to a great deal more than the slightly higher cost of the slimline *lead-lag* ballasts."

To put these facts to practical use—recommend Westinghouse slimline *lead-lag* ballasts. For more facts see The Man With The Facts—your nearby Westinghouse representative, or write Westinghouse Electric Corporation, Lighting Division, Edgewater Park, Cleveland, Ohio. J-04566

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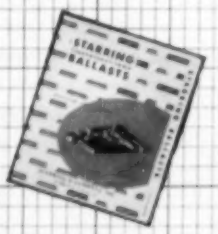

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THE JOURNAL OF THE ILLUMINATING ENGINEERING SOCIETY

December 1955

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The Problem of the Warehouse Ceiling...

To solve the problem of creating modern, low-ceiling office facilities from high-ceiling loft space in this Chicago warehouse, General Mills' engineer, Derril Blevins, chose the Curtis Light & Sound System. The fluorescent lighting system provides lighting of 45 footcandle average illumination with a visual comfort index of 90+. The sound system gives excellent acoustical results without costly installation and also hides the jungle of pipes, wires and sprinkling apparatus creating a modern low-ceiling effect. Even more important is the savings in time and money this Curtis system will continually provide as it permits servicing, maintenance and installation of additional pipe, conduit, ducts, etc. without either the loss of time or replacement cost a regular suspended ceiling would require.

Shown here is an actual "before" photograph of the warehouse before it was transformed by Curtis Light and Sound to the modern, attractive offices above. This is another of many outstanding installation problems throughout America that have been solved by the application of Curtis engineered lighting. To receive a copy of the illustrated brochure on the Curtis Light and Sound System, fill in the coupon and mail it today. No obligation of course.

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British Columbia Section
Pacific Northwest Region

Demonstration Facilities—Plus Function

. . . bring the principles of good lighting to the Society's farthest outpost in a winning installation

GEOGRAPHY is apparently no longer a deterrent in spreading the gospel of good lighting principles. Even the remotest, most northerly corner of the Pacific Northwest Region has within practical reach a demonstration center for "what to do." Its planning and lighting won for its designer, Walter J. Lind, first prize in both the Section and Regional contest for My Most Interesting Lighting Job.

Demonstration facilities were a prime factor in its design. But the area also had to be *used* — for an office, a warehouse, factory and store. As a business office the installation had to be investment-conscious and very very practical in regard to expenses. Its basic budget had to be planned, first to provide good basic office and warehouse lighting that would be a credit to I.E.S. standards. Then, whatever extra could be attained with it had to be of practical use and obtainable at a reasonable cost.

WALTER J. LIND who designed this winning installation, is with the Canadian General Electric Co., Ltd., Vancouver, B. C.

In the lighting design, for the many various locations, luminaires, light sources both filament and fluorescent, and application techniques, were selected purposely for both their functional, practical use, and to serve as demonstrations for various lighting systems. A tour of the building would show ways and means of lighting lobbies, offices, warehouses, parking areas, washrooms, lunch rooms, even kitchens. Almost every conceivable system could be shown — luminous ceilings, low-brightness troffers, suspended luminaires, flush luminaires, downlights. Coves, aisle lighting, display lighting. Whatever the system, however, their common denominator was the provision of the right lighting for the right place, as economically as possible.

Floodlighting of the building for night-time effect is very simply accomplished with an overhanging canopy into which are mounted 150-watt PAR lamps on six-foot centers.

One private office has a luminous ceiling, with careful attention to all surfaces as well. Other offices use low-brightness troffers, shielded troffers

and a variety of other systems, all with an eye to good lighting for the people who work there. For the general office, single-lamp Alzak troffers form the basic general lighting design. Switching permits the demonstration of 20, 30 or 50 footcandles on the desks. Since this area is also used for lecture purposes, lower and high intensities, plus flexibility were needed. Solution to this problem was to locate continuous rows of 40-watt rapid start lamps between the troffer rows and use corrugated Vinyl plastics as a diffuser. The combination of troffer and luminous elements gives 75 to 80 footcandles on the desks and 90 in the center of the room. When a projection screen must be used, the fluorescent lamps may be dimmed for comfortable viewing of slides. A cornice in this room gives added flexibility.

Because of the higher illumination levels used in the general office, brightness contrasts were even more closely controlled. Desks are a light mist green, woodwork of bleached mahogany, and draperies all of light values. The floor is a light green rubber tile with a red border strip. The wall facing the desk is a light grey and the rear wall was purposely finished in a fairly dark avocado green to provide a restful background for visitors as well as to lend interest to the general appearance of the office. This darker area is, of course behind the worker and does not affect his visual performance.

Entire details, including footlambert readings are available for every area of this building, though not expounded here. Each office, display area, and every room right down to the washrooms have been carefully planned for adherence to good lighting principles. The warehouse, as an example, uses a continuous row of twin lamps (96T12) slimline units mounted on 24-inch rods. There are three such rows. These provide 35 per cent upward light on a white ceiling and direct their 65 per cent downward component on the fixed aisles where it is needed most. Aisle lighting measures 60 footcandles at the center, with a high level of the all-important vertical illumination on the carton labels. There are two typical bays of 200-watt refractor units on 10 x 12 foot centers. Their location between rows of multi-shelf racks also serves to demonstrate shelf lighting. Supplementary lighting over the packing bench provides 90 to 100 footcandles.

Shown in the photograph is the entrance to the two-story building, showing the spotlighted stairway and high-lighted plantings. Upwards of 150-footeandles on both stairs and plantings are provided by 300- and 200-watt flush PAR lamps. Visitors, should they have to wait a few minutes, relax in a pleasant lobby featuring specially-lighted industry pictures, well-lighted upholstered seats and special display niches.

From the time the visitor enters the building, till he drives his car away from the lighted parking lot (150-watt wall-mounted refractor units) he is exposed to the effects of good, well-planned lighting. So, of course, are the employees — right through their lunch-hour, relaxation periods, and the working day.

General office area with single-lamp Alzak troffers and corrugated plastic luminous strips. When the projection screen is used, the fluorescent lamps may be dimmed for comfortable viewing of slides.

At the J. L. Lewis Paper Company airport are, left to right, J. L. Lewis, Jr., President, and R. Easton, Chief Engineer, of the company, with A. F. Bailey, of Westinghouse Electric Supply, examining threshold lights at the end of the NE-SW runway.

LIGHTING SPECS FOR

A Small Private Airport

Eastern New York Section
Northeastern Region

FROM a lighting standpoint, there were four problems presented by the installation at the J. P. Lewis Paper Company airport, at Beaver Falls, N. Y. Two of these problems were standard and two were quite special. They were all prescribed for by Randall H. Rice, and won first prize in his Section and Regional contests for My Most Interesting Lighting Job.

Beaver Falls is in the so-called "North Country" of New York State, characterized by hilly wooded terrain and subject to heavy snows. In building the airport it was necessary to cut one runway through the crest of a small hill to obtain the required landing length. At the end of this runway is a deep gully with obstructive trees.

Problem No. 1 — Standard. What type lights to use? Initial discussion with the owner centered around the semi-flush runway light. However, since snow and weeds will obscure the beams of this type unit, the new CAA Spec. L-802 Medium Intensity Elevated Light was used.

Problem No. 2 — Standard. What type circuit to use? Two choices were possible: the 6.6-ampere series circuit with advantages of uniform brightness, simple wiring and brightness control, or the 120/240-volt multiple (parallel) circuit with less complicated control and lower first cost. As it was posisble to hold voltage drop within permissible limits, the low first cost of the multiple system was the deciding factor in its selection.

Problem No. 3 — Special. How to mark, adequately, the hazardous banks where the runway cuts through the hill? Since visiting pilots often "drag" a runway before landing, the banks of the hill had to be marked to prevent the possibility of accidents. This was done by placing double red obstruction lights on tall steel poles along the sides of the runway, wired into the runway circuit.

Problem No. 4 — Special. How to guide pilots safely over the trees and deep gully at the end of the northeast runway. For this problem, a special lighting device was used, which projects a blinking "sandwich" beam of tri-colored light along the safe glide path. This device, called an Angle-of-Approach Indicator, has a yellow beam on top, green in the middle and red at the bottom. If the pilot sees yellow, he is too high; if he sees green, he is on the correct glide path, and if he sees red, well he is dangerously low.

The entire lighting system is operating to the complete satisfaction of the owners and users of the airport.

RANDALL H. RICE is with Westinghouse Electric Corp. in Albany, N. Y.

Arizona Section
Inter-Mountain Region

Design for Lighting A High School Gym

THE GYMNASIUM of Holbrook, Arizona, High School was planned and constructed to have facilities that will be adequate for even a 50 per cent increase in population in the next ten years, in this rapidly growing State. Therefore, in specifying the lighting installation, David M. Demaree designed a system which is in accord with good practice, for now and 1965, but which is not a heavy tax burden on the present 2500 population.

The gymnasium's interior is typical for high schools. Floor dimensions are 105 feet between end walls and 63 feet between balconies. The playing court is of regulation size. The ceiling has a 4 in 12 pitch starting with a center height above the floor of 40 feet. Ceiling and roof are supported by exposed bents of rigid frame steel. Ceiling surface is of white acoustical tile.

Mr. Demaree specified 300-watt and 500-watt standard RLM dome reflectors in four groups of six and two groups of three along each side of the court, at a mounting height of 32 feet above the floor. The groups are positioned evenly between the bents which are spaced on 24-foot centers.

The groups of six units use the 300-watt clear lamps and, in order to prevent a noticeable drop in illumination near the end walls, the end groups of three use 500-watt clear lamps.

To satisfy architectural considerations, the RLM reflectors are recessed between 2-inch by 12-inch headers spaced on 24-inch centers. The Arizona building codes pertaining to fire regulations were followed by lining these board troughs with ⅛-inch asbestos board. When mounted on a 4-inch octagon box, the reflector units finished out approximately flush with the finished ceiling, giving an effect of a recessed fixture when viewed from below.

As mounted in the 4 in 12 pitched ceiling, the reflectors are tilted from the vertical toward the center approximately 20 degrees, increasing the vertical footcandle level, and thereby the visibility of the seeing "task" on the court.

Over the balcony spectator area, 300-watt recessed lensed units are used for general area lighting. These, twelve over each balcony, are also mounted at an angle of 20 degrees from vertical.

Illumination level over the entire playing floor is a uniform 27 footcandles maintained at the side lines and 25 footcandles in the center. If desired, 500-watt lamps can be substituted for the 300-watt to raise the illumination to about 40 footcandles. Switching of the RLM units is by alternate groups of three to allow one level for scheduled games and another for practice and other school activities.

DAVID M. DEMAREE is an Electrical Consulting Engineer in Phoenix, Arizona.

Revealing Hidden Beauty in a Church

Milwaukee Section
Midwestern Region

LIGHTING installations in churches very often provide a greater satisfaction to the engineer because of the spiritual values created in revealing beauty for the pleasure of the worshippers. Richard L. Garber found this satisfaction in the lighting of two stained glass windows in a Milwaukee Lutheran Church. The installation also won for him the first place in his Section and Regional contest for MMILJ.

The church building committee had over a period of years been constantly improving and repairing the building. A new lighting system had been installed in the nave and chancel, and last year new tile floor and new carpeting were added. The chancel ceiling had been decorated with Japanese silver, imported for the first time in this country for this job.

Most recently they wished to do something about two stained glass windows, which were adding little to the beauty of the church interior. The one at the right could at times pick up the glow of the morning sun, but the other, only about ten feet away from the adjoining parsonage, was never shown to advantage.

To the illuminating engineer this question was one of brightness contrast. The central figure between the windows has a brightness of 20 footlamberts, and the walls 3 footlamberts, but the windows, the darkest things in the field of view, only about 0.4 footlambert.

The building committee had already contracted for a sheet metal company to cover the windows on the outside. This covering was to be glass, lined with sheet aluminum. Clearance from the brick exterior in to the window is eleven inches, window width is a little over six feet and its height is 19 feet.

A study of the densities of stained glass and experiment with different light sources — which involved a visit to a stained glass works — brought Mr. Garber to his decision on how to reveal the beauty of the windows. He insisted that the aluminum sheets be painted flat white on the inside, and mounted silver-sided incandescent lamps as close to the windows as possible in the space between, aimed at the white background. The lamps are mounted on simple double sockets on condulet fittings off the conduit run up each side of the windows.

The first cost of this installation was very low, as is the operating cost, due to the simple wiring and incandescent units used, but the results have surpassed expectations in adding to the beauty of the church.

RICHARD L. GARBER is with the Wisconsin Electric Power Company in Milwaukee, Wis.

Windows before . . .

. . . and after.

Floodlighting of the stained glass window, remarkable in its effect, was not turned on when this photo was taken.

milj

Toronto Section
Canadian Region

Ecclesiastical Effects—With Lumens

TRADITIONAL dignity, modern atmosphere, cast concrete construction. These were the problems handed to the lighting designer of this Presbyterian Church in Goderich, Ontario — with the added admonition that under no circumstances were any lighting devices to be visible to the congregation. Part of the architect's plan for the building was the desire that the ceiling recede, and the lighting be ethereal.

From the engineer's point of view (H. R. Nellis, Toronto), concealment areas were only 11 inches, allowing for minimum 45-degree shielding of light sources. Lamps had to be grouped together for easy placement, and as the floor was 40 feet from the ceiling, relamping was a major project. Reflectorized incandescent lamps were used since they (a) provided relatively long life, (b) required minimum dimensions, (c) aided in the elimination of harsh shadows by their multiple grouping, and (d) were in accord with the need for economy of both initial and overall costs.

Lighting for the main nave of the church was accomplished with ninety 150-watt reflector spotlights in bullet-type holders, provding a calculated illumination level of 15 footcandles, and a measured initial level of 21 footcandles. The units are mounted in close spacing, five behind each arch, on both sides. To provide a dramatic touch, and to subdue lighting during the sermon, a Luxtrol dimmer was provided, to be controlled by the church officer.

The large mass of wall was broken by an architecturally-designed cast concrete urn to provide interest light on the wall, and through a fibre-glass square in the bottom, some aisle light. This unit is the sole lighting for the narthex and back gallery. Under the gallery, several low-brightness lens units have been recessed.

To focus attention on the lectern and pulpit, it was necessary to use the then new 300-watt PAR-56 spotlight, as this lamp was the only one available with the narrow beam characteristics, as well as candlepower intensity required. Suitable holders for this lamp were not available in Canada, so one had to be designed. In the chancel, twelve 150-watt units of similar design provided the main basic

---

H. R. NELLIS, whose installation won first prize in his Section and Region, is manager of Lamp Sales, Northern Electric Company, Toronto, Ontario, Canada. Architect was Phillip Carter Johnston. Electrical contractor was Service Electric Co., Goderich, Ont.

light, with two 300-watt PAR56 lamps directed to the communion table.

Light oak was used in the furnishing throughout the church and a large panelled wall of oak formed the back wall of the chancel. To emphasize this important feature, single-strip fluorescent fixtures were used, with warm white lamps, in a matching wood cove. The cove is open at the bottom to allow some interest light on the lower chancel walls as well.

While the church was under construction, a stained glass window was donated. This provided an extremely challenging lighting task as the dark glass of the Holman Hunts "Light of the World" subject, 6 feet by 12 feet, was centered in a surround of light amber stained glass, 9 feet by 21 feet. Both the perimeter glass, as well as the main subject, had to be lighted as effectively as possible.

This was done by lighting the entire area with two 1500-watt medium beam floodlight units with a 59-degree spread lens in the vertical position. In addition, beamed to the inner subject-area only, two 1000-watt narrow beam floodlight units give additional light, color and depth to the stained-glass "picture." And finally, one 500-watt narrow-beam unit is aimed at Jesus' head. The "painting with light" technique employed for the stained glass is remarkably effective.

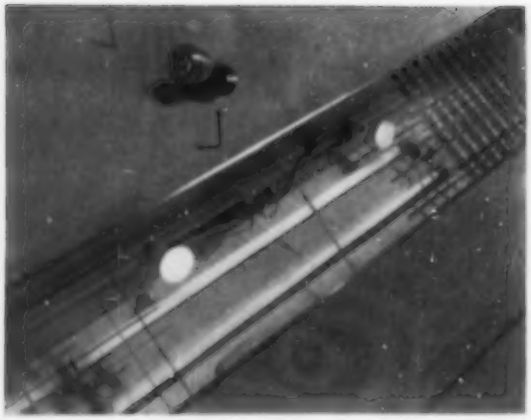
Architectural Treatment For Art Galleries

Alamo Chapter
Southwestern Region

Marion Koogler McNay Art Institute, in San Antonio, Texas, is a two-story, converted residence of Spanish type construction, originally built in 1927, with ceiling heights of approximately nine feet. This low ceiling height was an additional problem in the lighting installation, which had to meet the other art gallery conditions: flexibility; coordination of general and accent lighting; and 50 footcandles of 3000K to 4000K illumination with minimum reflections from the art objects to the viewers' eyes.

FLOYD A. COVINGTON, SR., is with the City Public Service Board, San Antonio, Texas; MR. COVINGTON, JR., is Chief Electrical Engineer and Project Coordinator, Post Engineers, Fort Sam Houston, Texas.

Floyd A. Covington, Sr., and Floyd A. Covington, Jr., who collaborated on the installation, which

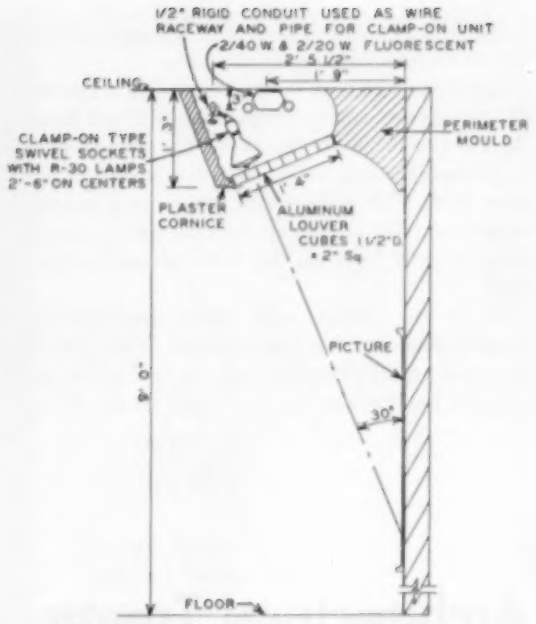


Cove unit with louver section removed.

won first prize in their Section and their Region for My Most Interesting Lighting Job.

Since it would have been difficult, and very expensive, to recess a large lighting system in the existing construction, they decided to use a cornice or inverted cove type installation around the perimeter of each gallery. Two rows of bare deluxe cool white fluorescent lamps run continuously around the perimeter, approximately 1¾ feet from the wall. Intermittently spaced R-30 75-watt floodlamps are mounted in adjustable pipe-mounting sockets, plugged into duplex receptacles in conduletes spaced 5 feet on centers. The ½-inch conduit mounting for the adjustable sockets is also used as the wireway for the receptacles.

Brushed aluminum egg-crate louvers with cells 1½ inches deep by 2 inches square are used to conceal the light sources and to aid in diffusing the light on the walls. When the pictures are viewed


1/2" RIGID CONDUIT USED AS WIRE RACEWAY AND PIPE FOR CLAMP-ON UNIT
2/40 W & 2/20 W FLUORESCENT
2' 5 1/2"
1' 9"
CEILING
CLAMP-ON TYPE SWIVEL SOCKETS WITH R-30 LAMPS 2'-6" ON CENTERS
PERIMETER MOULD
PLASTER CORNICE
ALUMINUM LOUVER CUBES 1 1/2" D x 2" Sq
PICTURE
30°
FLOOR

Elevation, showing angle of reflected light.

from two or more feet out from the wall, the source cannot be seen — in fact to see it at all, one must make a special effort and actually stand with his back to the pictures.

Illumination is approximately 50 footcandles over the full picture range. Recessed adjustable hood units, using 150-watt lamps, are provided in the center of the room as accent lights for objects displayed there. The light walls, floor and ceiling finish have made it unnecesary to provide for any general lighting in the center of the room.

Watch for the January Issue

To commemorate the Society's 50th Anniversary, the January 1956 issue of ILLUMINATING ENGINEERING will be a very special number. Significant developments in lighting for the past 50 years will be presented for the first time within one book. Because of its special value, several thousand extra copies are being printed, to be available on order to I.E.S. Headquarters.

Operation of Mercury Vapor Lamps on Series Street Lighting Circuits—Part II

By C. F. SCHOLZ
M. E. KECK
W. A. OGLESBEE

IN A PREVIOUS paper[1] the authors discussed the basic principles of operation of mercury vapor lamps on straight series circuits, the equipment components needed and system operation under both steady state power supply conditions and abnormal power supply conditions. The previous paper discussed operation of only the 400-watt E-H1 mercury lamp on a 3.3-ampere straight series system. During the past year the work has been extended to include investigation of radio interference problems on overhead circuit systems and transient voltage conditions during starting. In addition the investigation of the operation of an experimental 6.6-ampere, 20 000-lumen mercury lamp for use on standard 6.6-ampere moving coil constant current transformers is reported.

Transient Voltage Conditions During Lamp Starting

During the lamp starting period there are two conditions which create a short duration, high voltage stress on the film cutout. These are essentially independent of each other and are a function of the constants and the portion of the cycle at which the oil switch is closed. In order to investigate the behavior of straight series systems at variable temperatures and with variable circuit constants a laboratory circuit was set up using lumped components of resistance, inductance and capacitance. Fig. 1 indicates the basic circuit and the method of connecting the circuit elements between individual lamps to approximately simulate the series system with underground cable. The individual values of resistance, inductance and capacitance used for simulated underground circuits were as follows:

R_1 through $R_6 = .0157$ Ohms
L_1 through $L_6 = 8.5$ Microhenries
C_1 through $C_3 = .002$ Microfarads

It is realized that the values above will vary from installation to installation and for that reason the circuit was also tested with the idealized condition of zero capacitance to ground to simulate the least favorable starting condition for overhead circuits.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHORS: Westinghouse Electric Corp., Lighting Division, Cleveland, Ohio.

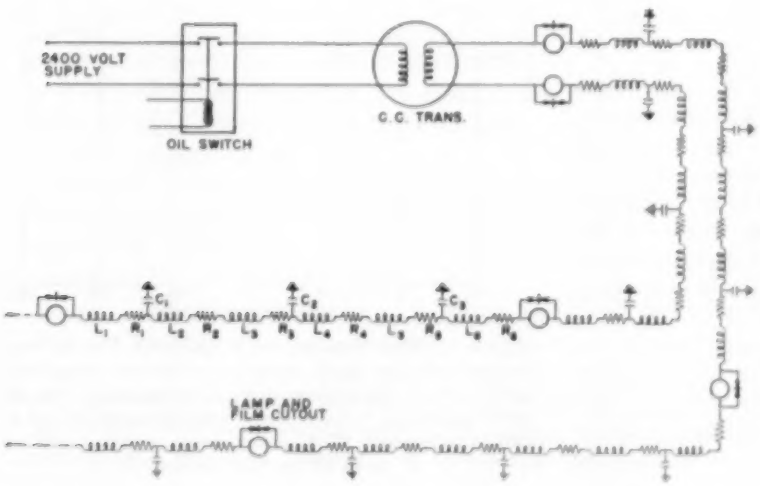


Figure 1. Laboratory circuit utilizing lumped constants simulating an underground cable series system. Entire system adapted to operate in cold chamber.

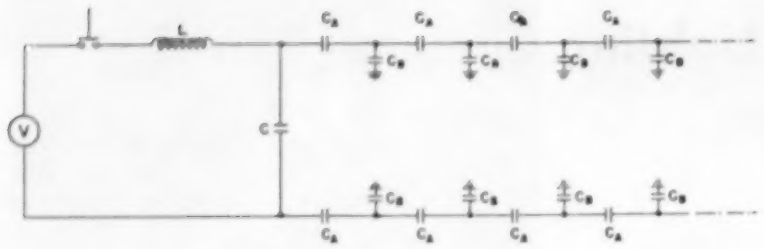


Figure 2. Equivalent circuit of straight series system.

V = INSTANTANEOUS VALUE OF APPLIED VOLTAGE
C = CAPACITANCE CORRESPONDING TO NATURAL FREQUENCY OF OSCILLATION OF C.C. TRANSFORMER
L = REGULATOR LEAKAGE INDUCTANCE (COILS CLOSED)
C_a = CAPACITANCE OF ONE LAMP & FILM CUTOUT IN PARALLEL
C_b = CABLE OR OVERHEAD CAPACITANCE TO GROUND

Using the circuit of Fig. 1 and a moving coil constant current transformer it was found that prior to lamp conduction the open circuit voltage of the regulator is distributed unequally with nearly all the voltage concentrated across the pair of lamps adjacent to the constant current transformer. Using the equivalent circuit shown in Fig. 2 the voltage across the first lamp, prior to any conduction, may be calculated using the following relationship:

$$\frac{V_c}{2}\left[1-\frac{\operatorname{Sinh}(N-1)\sqrt{\frac{C_b}{C_a}}}{\operatorname{Sinh} N\sqrt{\frac{C_b}{C_a}}}\right].$$

V_c = Voltage across C.
N = Number of pairs of lamps counted from center of circuit.
C_a = Capacitance of one lamp and film cutout in parallel.
C_b = Capacitance to ground of cable or overhead line.

The rate of rise of the voltage V_c will be quite rapid and is a function of the resonant frequency and rating of the constant current transformer and the point of switch closure. The rate of rise of voltage for a 30 kw, 6.6-ampere constant current transformer is approximately as shown by the dotted curve on Fig. 3. The voltage necessary to initiate conduction through a mercury vapor lamp is a function of the rate of rise of voltage. This relationship for various linear rates of rise is also shown on Fig. 3 and it follows that the film cutout used with these lamps must have either a sufficiently high voltage rating or impulse resistance to withstand this stress. The value of voltage and rate of rise are a function of the portion of the cycle at which the oil switch closes. The conditions will be most severe when the switch is closed at the peak of the wave of the 60-cycle supply voltage.

The second cause of a high voltage stress on the film cutout is the result of a traveling wave caused

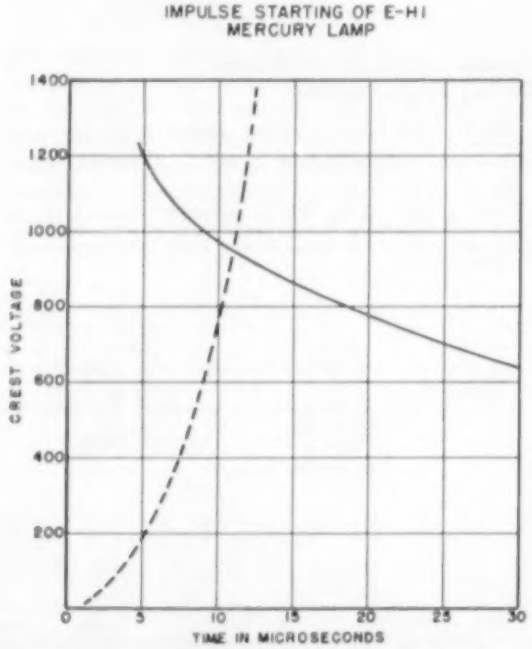


Figure 3. Time required to break down 3.3- or 6.6-ampere mercury vapor lamps on a linearly rising impulse voltage. Data taken at room temperature. Dotted curve represents voltage versus time characteristic of a 30-kw, 6.6-ampere C. C. transformer, switch closed at peak of applied voltage.

by the successive charging and discharging of the cable through each pair of lamps as they become conductive. The exact behavior of this transient is complex and it is not the purpose of this paper to set forth its behavior thoroughly. An oscillogram of this transient, as it appears across the center pair of lamps in the circuit is shown in Fig. 4. The value of the transient for the circuit shown in Fig. 1 is approximately 958 volts and its duration is about 10.5 microseconds.

Some voltage peaking does exist during the first few cycles of lamp operation during the forming of a permanent cathode hot spot. However, it is the authors' opinion that the items discussed above are the most cirtical as regards stressing the film cutout.

The use of a relatively high voltage film cutout to meet the above conditions necessitates the use of a mercury lamp with an internal flashover voltage of the components within the outer bulb of well over 2500 volts. The E-H1 lamp has been altered in its internal construction so that its impulse flashover voltage is now about 3000 volts.

Operation of Experimental 6.6-Ampere Lamp On Straight Series Circuits

Since the announcement of the practicability of operating the E-H1 mercury lamp from a 3.3-ampere constant current transformer without conventional isolating transformers, a number of engineers, power companies and municipalities have evidenced interest in a 20,000-lumen mercury lamp which has an operating current of 6.6 amperes. Such an experimental lamp has been developed and successfully operated on full scale laboratory circuits using different distributed capacitance and inductance elements to simulate underground and overhead circuits as indicated in Fig. 1 and the above discussion.

These 6.6-ampere mercury lamps behave in a manner similar to the E-H1 lamp and require that a time delay device and voltage sensitive element be incorporated into the circuit. The approximate characteristics of these experimental lamps are:

Lumen Output — 20,000
Operating Current — 6.6-Ampere
Operating Voltage — 75
Operating Watts — 430
Impulse Flashover Voltage — 3000

Lamps were tested in the simulated underground circuit of Fig. 1 and the transient voltage condition referred to before was found to exist and the recommended air gap film cutout voltage is approximately 900 volts rms. Lamps were tested as to stability with regard to interruptions of varying

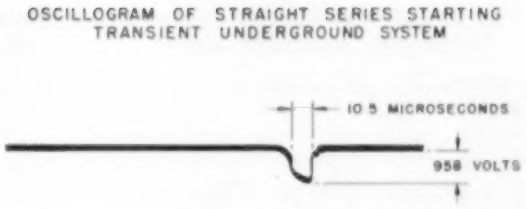


Figure 4. Oscillogram of straight series starting transient with laboratory circuit of Fig. 1. Data taken at room temperature.

durations versus available voltage to restart the lamps. The relationship as indicated in Fig. 5 was determined. The experimental lamp is somewhat more stable than the E-H1 lamp. Voltage sensitive relaying equipment of the type described in the previous paper[1] will therefore assure satisfactory service under both normal and abnormal power supply conditions.

The stability of operation appears to be satisfactory, when used with proper relaying equipment, to permit operation of as many lamps as can be satisfactorily started at the temperature to be found in service. The maximum number of lamps which can be started from a given size of constant current transformer is a function of temperature, open circuit voltage and circuit constants. The

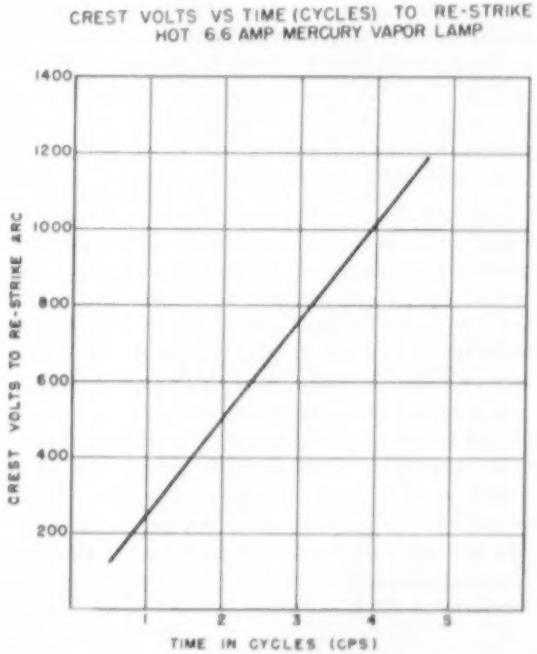


Figure 5. Crest volts needed to restrike a hot 6.6-ampere mercury vapor lamp is a function of time after zero in the lamp.

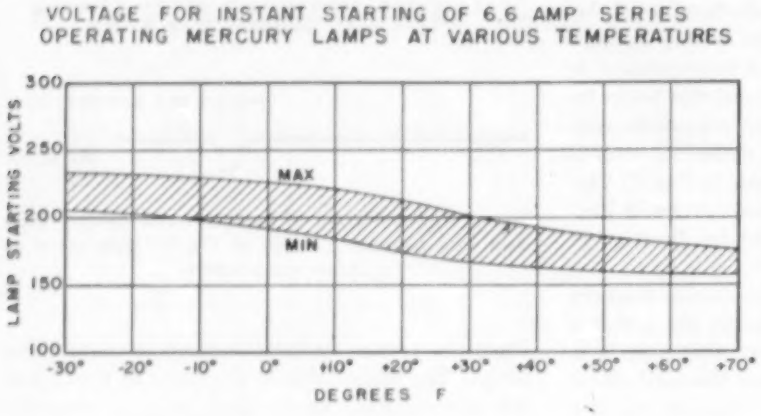


Figure 6. Voltage required for starting of 6.6-ampere experimental mercury lamps. For circuits employing over 20 lamps the probability of having one or more lamps with minimum characteristics is good.

curve of lamp voltage necessary for starting versus temperature for this lamp is shown in Fig. 6. For an idealized overhead circuit with practically no distributed capacitance to ground, this curve applies without modification. Actual tests with a 30 kw, 6.6-ampere C.C. transformer indicate that 37 lamps (164 volts per lamp) can be started at an ambient of 70°F. and that 30 lamps (204 volts per lamp) can be started at −20°F.

For a typical underground circuit with the values of capacitance to ground as aforementioned, more lamps can be started since the voltage between lamps is not distributed equally. Tests on this simulated underground circuit with a 30 kw 6.6-ampere C.C. transformer indicate that 47 lamps can be started at 70°F and 37 lamps can be started at −20°F. This does not mean that the voltage per lamp required for starting is reduced below that shown on the curve of Fig. 6 but rather that a non-uniform initial distribution of voltage exists.

The time sequence of events which occurs may be stated as follows: As indicated in the previous discussion practically the entire open circuit voltage of the C.C. transformer is concentrated across the first pair of lamps before conduction starts in these lamps and this voltage is transferred to each pair of lamps in turn. After all lamps start conducting the voltage across each lamp is a function of impedance of the lamps and the circuit capacitance to ground. If the circuit consists of too great a number of lamps the current value is too low to permit the prompt formation of a permanent cathode hot spot which is required for satisfactory starting. Instead, the lamps conduct by means of a low current discharge which is detrimental to lamp life and may be too small to hold in the series operating coil of any protective relay used to sense an open circuit condition. Oscillograms indicating both satisfactory starting and low current starting are shown in Fig. 7 (a) and (b). For satisfactory lamp life low current starting must be avoided. Tests indicate that for a marginal number of lamps the distinction between satisfactory starting and low current starting is a function of point of closure of the oil switch on the 60-cycle supply line. At the time of this paper the investigations do not permit publishing a table of the number of lamps which may be started at all temperatures and with different values of cable capacitance to ground.

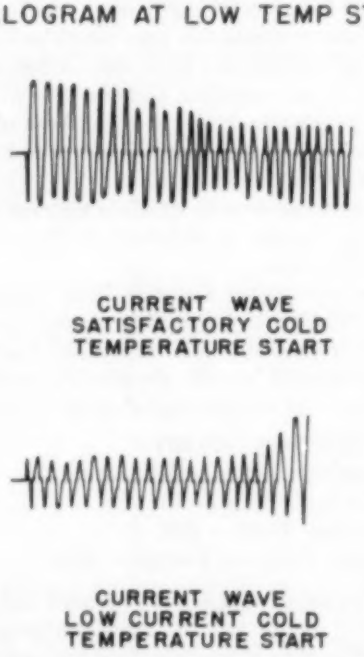


Figure 7. Oscillograms indicating relative values of current during satisfactory cold temperature start and during a low current cold temperature start caused by an excessive number of lamps in the circuit.

Mixed Operation of Incandescent Lamps And 6.6-Ampere Mercury Vapor Lamps

Since the experimental 6.6-ampere mercury vapor lamps operate at a standard series circuit current it is feasible to operate a mixed circuit of incandescent and mercury vapor lamps. The addition of incandescent lamps does not affect the voltage available for starting the mercury lamps since the incandescent lamps have a low resistance when cold and the full open circuit voltage of the C.C. transformer is hence available to start the mercury lamps. The film cutouts used for the incandescent lamps may be of the conventional type with a breakdown voltage of the order necessary to insure satisfactory operation of that lamp. Conventional methods based on circuit wattage and power factor may be used in determining the maximum number of lamps of each type for optimum regulator loading provided the maximum number of mercury lamps that can be started is not exceeded.

Radio Interference

A few isolated instances of radio interference have been reported from straight series circuits with mercury vapor lamps and overhead circuits. The interference is of a somewhat unusual nature since it occurs only during the time when both the lamps and a radio transmitter are operating and is tunable to the frequency of the station. The series loop acts as an antenna which receives the radio frequency signal and an R.F. current is then induced into the series loop and circulating through the lamps, which, being non-linear elements when operating, modulate the r.f. current which is then rebroadcast by the loop acting as an antenna and received as noise. This noise is thus tunable and does not occur if the lamps are inoperative or the station leaves the air. The radiated signal attenuates rapidly and the severity of the noise condition is a function of the original signal strength and direction, and the location of the receiver. The interference can be reduced to a negligible amount by the installation of an r.f. bypass (single capacitor) across each film cutout holder so that the r.f. current does not circulate through the lamp and hence is not modulated by it.

Conclusions

Insufficient time has elapsed to appraise the field operating experience of 3.3-ampere straight series systems as regards abnormal power supply conditions. At present a considerable number of 3.3-ampere systems are in operation and are operating satisfactorily on a daily starting basis. There is considerable demand to increase the number of lamps used per regulator based on starting at normal temperatures on circuits with few power interruptions. The authors feel that the limiting factor in regard to the number of E-H1 lamps that can be satisfactorily operated is not that of starting the lamps but rather the performance under voltage dips or interruptions of the order of ½ cycle in duration.

The advent of the 6.6-ampere lamp, for which the limiting factor is the number of lamps that can be started at the temperatures involved, will reduce the likelihood of system trouble as a result of instability during short interruptions. The 6.6-ampere lamp also makes it possible to convert existing incandescent lamp straight series systems to the operation of mercury lamps without isolating current transformers and with a mixed loading of mercury and incandescent lamps. It is believed that it will find considerable use in the streetlighting being planned for tomorrow's installation

Reference

1. Keck, M. E., Oglesbee, W. A.: "Operation of Mercury Vapor Lamps on Series Streetlighting Circuits," ILLUMINATING ENGINEERING, Vol. L, pp. 115-122 (1955).

DISCUSSION

J. PETERSON:* This paper presents some aspects of straight series operation that are probably quite significant in the particular systems sponsored by the authors of the paper and where air-gap cutouts are used. While the authors' data specifically covers underground circuits, I presume it is to be inferred that the similar capacity effects are present on overhead circuits but to a lesser degree. I would be interested in the magnitude of the effects on overhead circuits.

When copper oxide film cutouts are used on overhead circuits we believe that the resistance characteristic of this type of cutout tends to wash out the distributed capacity effects. We have also found that a finite resistance shunted across the lamp and cutout will completely control the distribution of voltage among the lamps at starting rather than distributed capacity.

Incidentally, an appendix to the paper describing the analytical and mathematical approach used in arriving at some of the conclusions would clarify some of the statements made in the paper.

Regarding radio interference, I assume the authors mean the radio frequency is modulated at a 120-cycle rate by the 120-cycle variation in arc impedance. Here again, I suspect the copper oxide type of cutout exerts a bypass action to some degree and minimizes this type of difficulty.

P. B. CLARK:** There is a formula given on page 580 for finding the voltage appearing across the first lamp prior to conduction. No derivation is given nor are there any clues as to how this formula was obtained. It would be quite interesting to see exactly what factors were taken into account or omitted in the process of deriving this formula.

*General Electric Co., Lynn, Mass.
**Line Material Co., South Milwaukee, Wis.

The terminology used on page 581 describing voltage breakdown of mercury vapor lamps is quite ambiguous and further clarification would be helpful. In one sentence the authors mention "internal flashover voltage" which implies a 60-cycle voltage. In the next sentence they speak of "impulse flashover voltage." This would refer to a surge type of wave. We have tested many lamps of several manufacturers and find that very few lamps exceed 2500 volts rms flashover. I think this paragraph on voltage breakdown justifies further clarification.

The authors described some of the characteristics of new experimental lamps designed for operation at 6.6 amperes. The lumen output is listed as 20,000 lumens at 420 watts. No mention is made if these lamp values are for vertical or horizontal burning. Some lamp manufacturers claim that, due to increased electrode drop at 6.6 amperes, 460 watts are required to produce an initial (100 hours) 20,000-lumen output when this type of lamp is burned horizontally. The latest figures that we have obtained from a lamp manufacturer indicate that this type of lamp requires 440 watts in order to emit to 20,000 lumens in a horizontal position. All the above figures indicate that there is considerable deviation in the data presented in this paper. It would appear that studies should be made to determine if the high current density of this 6.6 ampere lamp might cause considerably poorer lumen maintenance than that obtained with the 3.2 ampere lamps.

The authors make a statement concerning starting voltages of lamps, which is as follows: "If the circuit consists of too great a number of lamps the current value is too low to permit the prompt formation of a permanent cathode hot spot which is required for satisfactory starting. Instead the lamps conduct by means of a low current discharge which is detrimental to lamp life and may be too small to hold in the series operating coil of any protective relay used to sense an open circuit condition." We have found exactly this same situation. It should be borne in mind, however, that this is a condition that occurs only with moving coil regulators. Our testing indicates that the resonant circuit regulators always supply ample starting current for lamps up to the design kw load rating even when starting lamps at temperatures of -20 F.

Mixed load operation of both mercury and incandescent lamps is accomplished on the systems using resonant circuit regulators, by connecting the incandescent lamps to insulating transformers having a 3.2-ampere primary winding that is in series with the direct series connected mercury lamps.

Our findings concerning radio interference on direct series mercury vapor lamp circuits is exactly parallel to that discussed by the authors. It is interesting to note that this is a rather unusual type of radio interference seldom encountered in distribution systems. It should be noted that this interference can only be encountered with overhead series distribution systems. The application of a by-pass capacitor to shunt the radio frequency current around the lamp as described by the authors is exactly the same method that we have been using.

I would like to point out in concluding that there are on the order of 200 direct series connected mercury vapor lighting systems using resonant circuit type of regulators in operation at present. A considerable quantity of these have been in operation for more than three years. They are located at practically all latitudes of the United States and also in Mexico and Alaska.

C. F. Scholz, M. E. Keck, W. A. Oglesbee:* The authors wish to thank the several discussors of this paper for their comments which enable us to present a clearer picture of this investigation.

In regard to the question from Mr. Peterson, we have the following comments:

Due to the infinite number of possibilities that are encountered in actual installations, only a few actual simulated circuits were mocked up. The values of resistance, inductance and capacitance used for the simulated overhead circuit were:

R_1 through $R_6 = .105$ ohm
L_1 through $L_6 = 226.5$ Microhenries
C_1 through $C_3 = 100$ Micromicrofarads

The effect of the decreased capacitance has a negative effect on the circuit in that fewer lamps can be started on the same type of regulator. This condition would seem to be further aggravated if the copper oxide film cutouts "washed out" the distributed capacity effects.

The value of the copper oxide type of cutout as a bypass for radio frequency current seems questionable and, by its very nature, would not be as effective as an element whose impedance varies with frequency.

As regards the comments from Mr. Clark, we wish to advise as follows:

For the formula given on page 580, see Everitt, *Communication Engineering*, Second Edition, page 160. With the circuit constants as they are found in this application, and the rates of rise of voltage described in this paper, the initial distribution is determined, for practical purposes, by the capacitance network. Oscillations due to inductance may be neglected.

In our investigation of the internal flashover characteristics of the lamps, we used lamps which contained a high pressure nitrogen fill in the outer envelopes to improve this arc-over characteristic. We found that with slow rates of rise of voltage, it was impossible to cause arc over in the outer envelope even with hot lamps. For this reason, we used an impulse test with a very rapid rate of voltage rise. Such a test is applicable since under field conditions the lamps may be subjected to such an impulse.

The design characteristics for the lamps were those forwarded by the lamp manufacturer for a vertical burning lamp. Further data on operating figures will have to be obtained directly from the manufacturer of lamps which are the commercial equivalent of the experimental lamps tested.

*Authors.

INSTALLATION AT FILENE'S, BOSTON, MASS.

Lighting a Display Window

LIGHTING OBJECTIVE: To provide dramatic display illumination of sufficient quantity to eliminate exterior reflections in the glass.

GENERAL INFORMATION: The area shown above measures 18 feet 6 inches by 6 feet, glass height is 7 feet 10 inches. The window faces a narrow street. Fig. 2 shows reflections in the glass during the day with no display illumination.

INSTALLATION: One hundred footcandles of general lighting as shown in Fig. 3 are provided by three parallel rows of two-lamp 8-foot fluorescent luminaires using 96-inch T-8 white slimline fluorescent lamps. Merchandise is highlighted by PAR-46 (200-watt) narrow beam spots mounted on 12-inch centers across the front of the windows. Pin-point spot lighting is provided by groups of four specially adapted 30-watt PAR-36 6-volt auto spot lamps installed behind the front window baffle and along the sides of the window. Fig. 4 shows the window lighted with fluorescent lamps and PAR-36 and PAR-46 spots; although there is 1000 to 1500 footcandles on the mannequins, some reflections are still visible. To eliminate all reflections the general lighting level was increased to 200 footcandles by adding 150-watt R-40 flood lamps on 12-inch centers along the front of the window to give the result shown in the large photograph. To provide colored background effects a strip of Century Lighting stage units using 150-watt R-40 spot lamps with red, blue and green spread lenses was installed across the rear of the windows.

(over)

A.I.A. File No. 31

Figure 2. Reflections in the display window glass during daylight with no display illumination on.

Figure 3. General lighting provided by slimline fluorescent lamps does not provide sufficient illumination to combat display window reflections from outside sources.

Figure 4. (above) PAR-36 and PAR-46 spot lamps in addition to the slimline fluorescent lamps help to minimize distracting reflections in the display window.

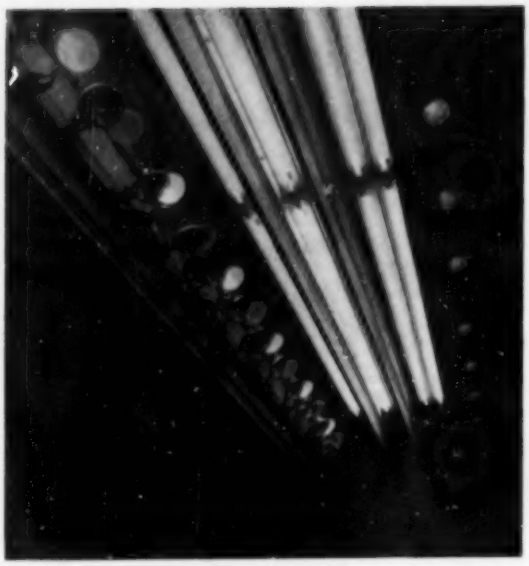


Figure 5. (right) Slimline fluorescent and incandescent lighting equipment mounted in the display window.

All lighting equipment is concealed from exterior view by a baffle painted white on the inside and the same color as the background on the outside. National Plug-In strip is mounted in the back of the windows for additional special effects. The wiring is asbestos heat-resistant wire in conduit, and the windows are ventilated so the temperature will not exceed 110F. Each window is wired to accommodate a connected load of 6 kilowatts.

Lighting designed by General Electric Co., Nela Park, Cleveland 12, Ohio; installed by James Wilkinson and Co., Boston, Mass.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, New York.

Series XX 12-55

Luminaire Light Distribution Principles

By CHARLES REX

MODERN ROADWAY lighting practice involves luminaire light distributions which are controlled and proportioned to provide efficient seeing and to aid the rapidly increasing night use of our multibillion dollar investment in motor vehicle transportation. Streets, highways, autos, trucks and busses represent a business which must be kept open after dark.

The comfort, convenience, and safety objectives of luminaire development and application are of significance to the public. Hence there is an impelling obligation to investigate and evaluate prospects for the improvement of the seeing effectiveness of roadway lighting. This engineering work is currently underway. It includes several of the Society's Committee and Research activities.

Correlation of objective data with laboratory, field, calculated, and in-practice studies will have a common basis comprising the roadway, the vehicle and the driver. This obviously should be the basis for the presentation of luminaire light distribution data.

This paper includes suggested methods for presentation of the current light distribution principles for better understanding and appreciation of the considerable effect which directional control and proportioning of luminaire candlepower has on the factors involved in seeing.

Light Distribution from Longitudinal Roadway Lines

Candlepower distribution curves should be consistent with seeing data and the dynamics of typical motor vehicle movement along the roadway. These movements are generally linear. The eyes of the proceeding driver or observer view a succession of brightness areas which may be represented by the brightness along longitudinal roadway lines. This viewing is constantly subject to fluctuating adverse brightness effects from luminaire brightness and light entering the vehicle windshield.

Inclined Plane Candlepower Curves

For example, the candlepower distribution curves shown in perspective diagrams Figs. 1 and 2 are directly related to the well-known pavement brightness factor in roadway lighting. The shape of the luminaire candlepower curve is proportioned to obtain the desired pavement brightness at typical locations when observed from a typical series of specific driver viewing positions. Assuming constant conditions of pavement reflection and viewing, an increase or decrease in pavement brightness on the roadway is directly proportional to differences in the candlepower light distribution curves. Hence the effectiveness of different candlepower distributions, in providing pavement brightness, may be compared without the necessity of the customary intermediate brightness computations.

Representative Roadway Lines

The number of longitudinal roadway lines along which the luminaire light distribution data should be provided, obviously depends upon the variables involved and the detail desired. The 0.5 MH (mounting height) and 1.5 MH longitudinal lines[1,2] might be representative of the most important pavement areas of a typical roadway layout such as that shown in Fig. 3. Similarly, longitudinal lines at *H* ("House Side") 0.5 MH and 2.5 MH street side may be representative of the areas adjacent to the pavement.

Brightness stations are spaced at uniform longitudinal distances along the roadway in multiples of the mounting height. The accompanying transverse lines form unit areas. Road brightness stations designated X might be typical of those used for field investigations or check of calculated data. For the purpose of this paper, data have been calculated at longitudinal intervals of 0.5 MH up to distances of 10.5 MH from each luminaire.

As shown in Fig. 3, the observer view and direction of travel is toward luminaires No. 3, No. 4, No. 5 and No. 6. The suggested observer-eye position is 4.3 feet[3] above the pavement with a longitudinal road brightness viewing distance of 7 MH, which with 30 feet MH is 210 feet. All subsequent illustrations are based upon observer positions along the longitudinal roadway line at transverse distance of 1.5 MH with respect to luminaires No. 1 or No. 3 (which is at 0.5 MH with reference to luminaires such as No. 2 or No. 4).

The inclined-plane candlepower distributions

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. AUTHOR: Outdoor Lighting Dept., General Electric Co., Lynn, Mass.

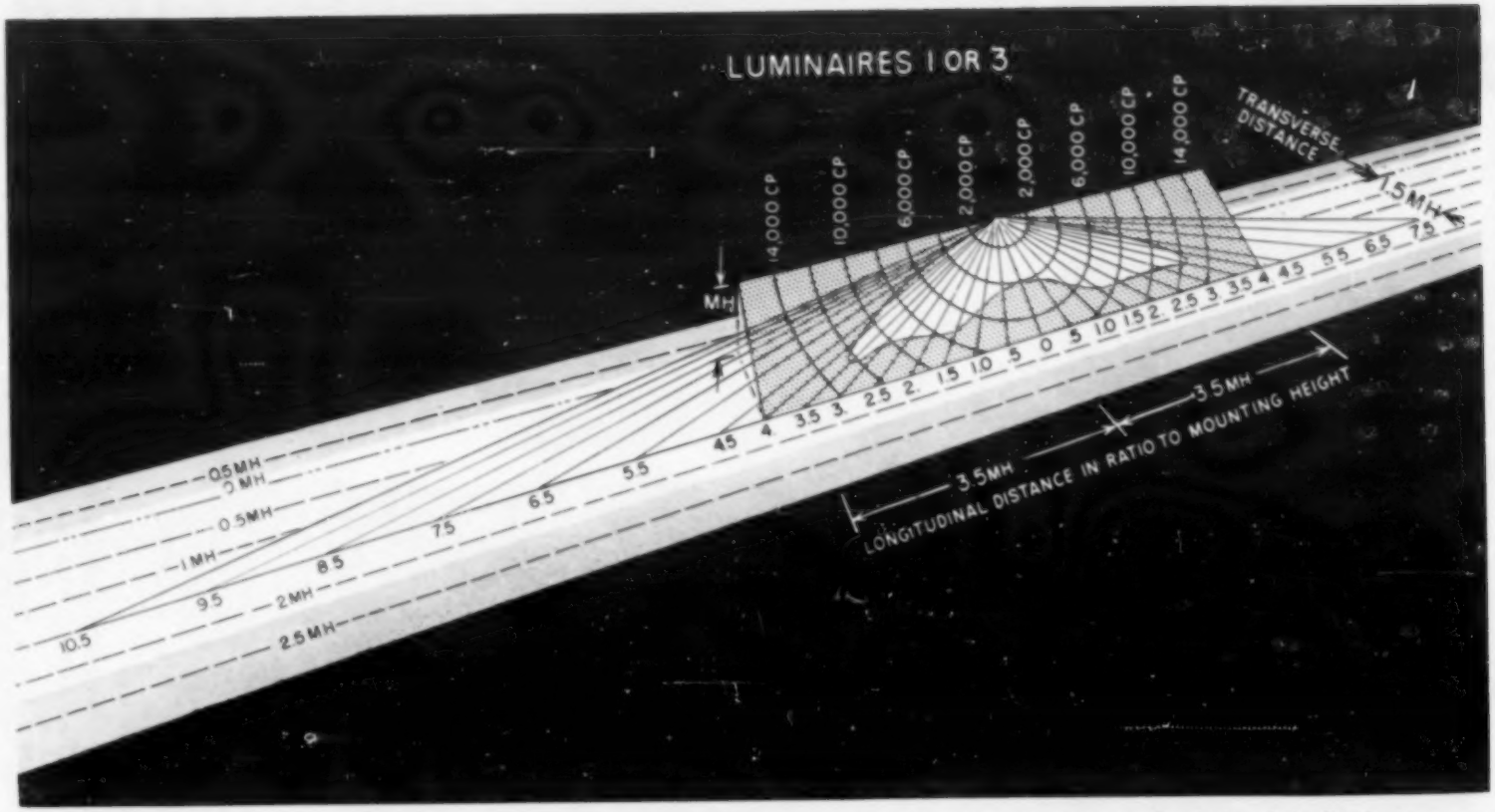


Figure 1. Buildup and proportioning of luminaire candlepower along 1.5 MH longitudinal roadway line shown in an inclined plane light distribution curve. From specified driver-observer and viewing distances, variations in pavement brightness are in proportion to variations in candlepower. This light distribution curve is hypothetical from Figure 15.

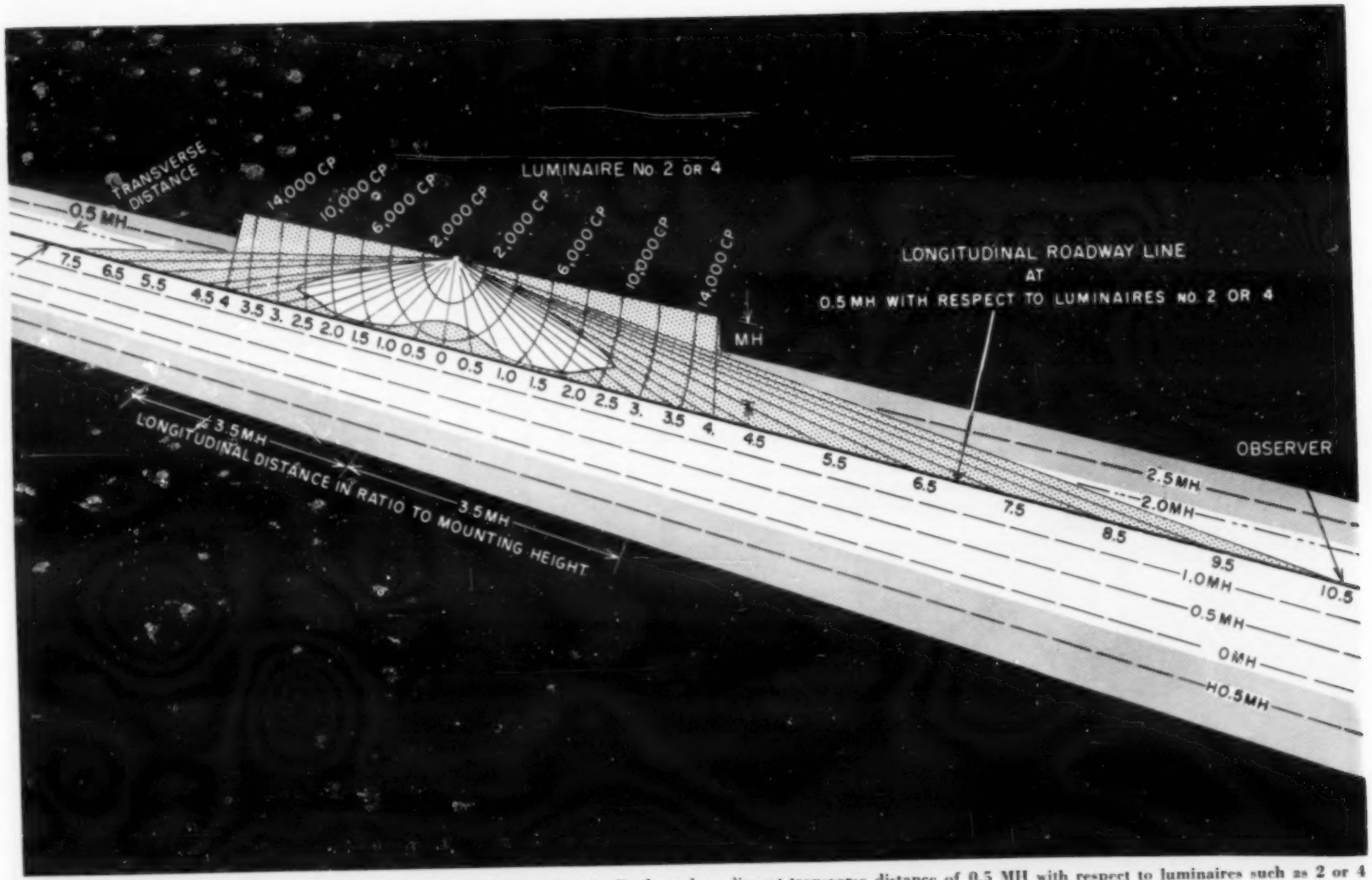


Figure 2. Directional control of luminaire candlepower along a longitudinal roadway line at transverse distance of 0.5 MH with respect to luminaires such as 2 or 4 and at transverse distance of 1.5 MH with respect to luminaires such as 1 or 3.

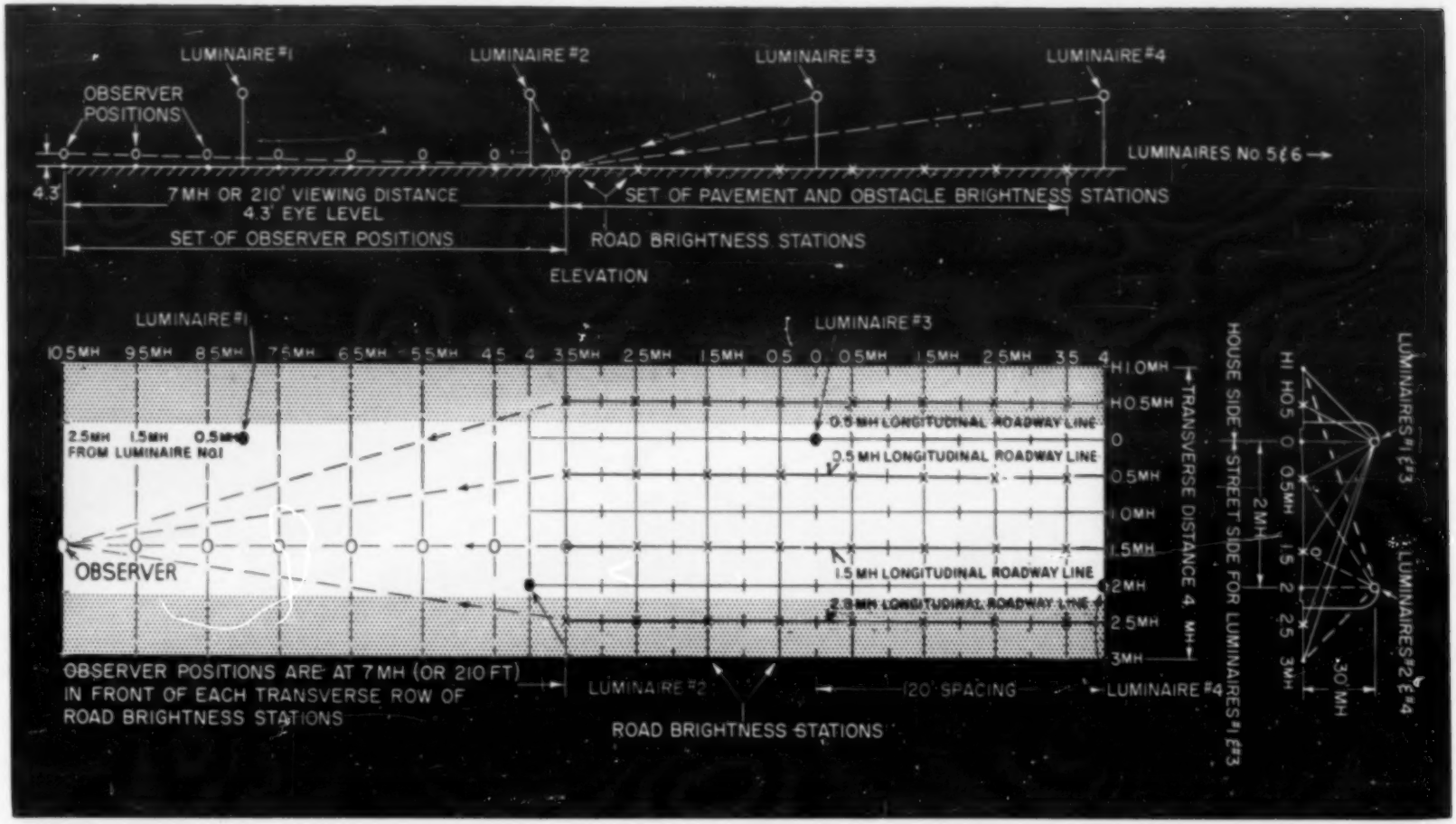


Figure 3. Representative layout of longitudinal and transverse roadway lines, driver-observer positions, and luminaire locations assumed for purpose of explanation and calculation of pavement brightness. Note in transverse section at right that 1.5 MH line with respect to luminaires No. 3 and No. 5 is the same as 0.5 MH line with respect to luminaires No. 2 and No. 4.

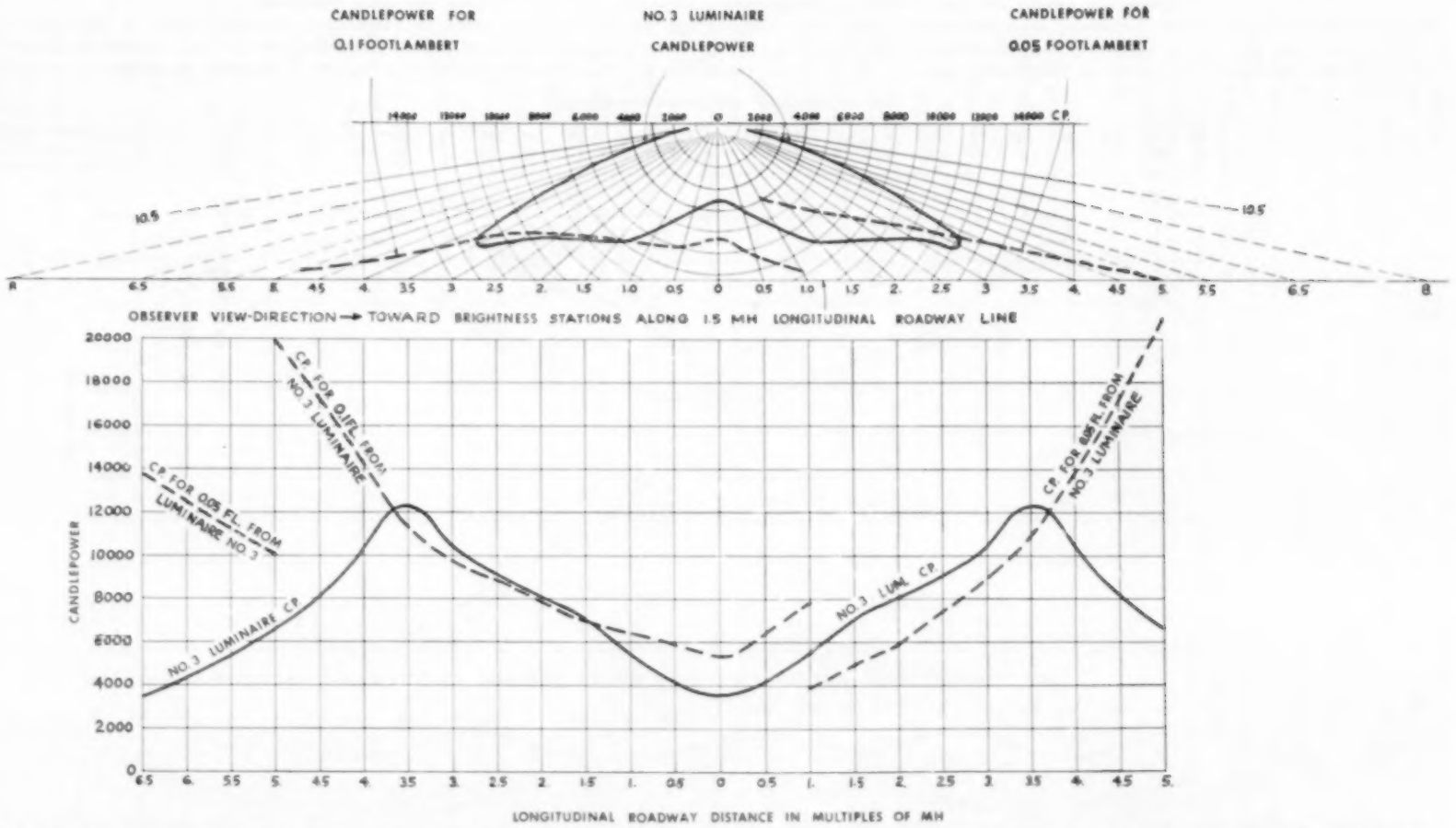
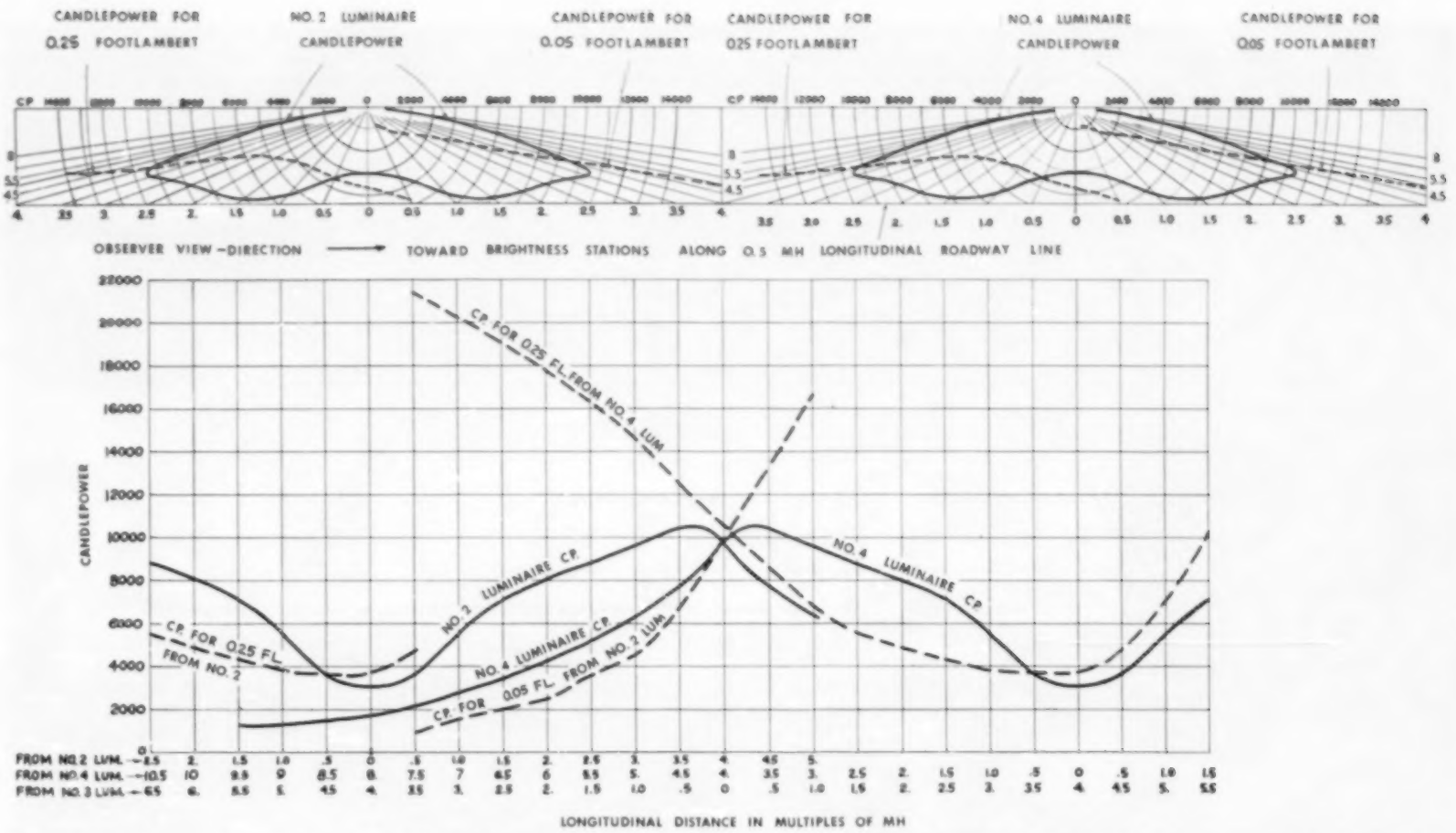

CANDLEPOWER FOR 0.1 FOOTLAMBERT
NO. 3 LUMINAIRE CANDLEPOWER
CANDLEPOWER FOR 0.05 FOOTLAMBERT
OBSERVER VIEW-DIRECTION → TOWARD BRIGHTNESS STATIONS ALONG 1.5 MH LONGITUDINAL ROADWAY LINE
CANDLEPOWER
CP FOR 0.1 FL. FROM NO. 3 LUMINAIRE
CP FOR 0.05 FL. FROM LUMINAIRE NO. 3
NO. 3 LUMINAIRE CP
NO. 3 LUM. CP
LONGITUDINAL ROADWAY DISTANCE IN MULTIPLES OF MH

Figure 4. Candlepower required to produce uniform 0.1 and 0.05 footlambert levels of linear pavement brightness along the 1.5 MH longitudinal roadway line and diver-observer viewing path. Upper diagram shows plane-of-paper projection of 1.5 MH inclined plane light distribution from luminaire comparative interpolation gives pavement brightness produced by luminaire, based upon Reid-Chanon data for asphalt pavement.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NO. 4 LUMINAIRE CANDLEPOWER
CANDLEPOWER FOR 0.05 FOOTLAMBERT
OBSERVER VIEW-DIRECTION → TOWARD BRIGHTNESS STATIONS ALONG 0.5 MH LONGITUDINAL ROADWAY LINE
CANDLEPOWER
CP FOR 0.25 FL. FROM NO. 4 LUM.
NO. 2 LUMINAIRE CP.
NO. 4 LUMINAIRE CP.
CP FOR 0.25 FL. FROM NO. 2
NO. 4 LUMINAIRE CP.
CP FOR 0.05 FL. FROM NO. 2 LUM.
FROM NO. 2 LUM. →
FROM NO. 4 LUM. →
FROM NO. 3 LUM. →
LONGITUDINAL DISTANCE IN MULTIPLES OF MH

Figure 5. Candlepower from No. 2 and No. 4 luminaire locations required to produce uniform 0.25 and 0.05 footlambert levels of linear pavement brightness along longitudinal roadway line and driver-observer viewing path at transverse distance of 0.5 MH with respect to luminaires No. 2 and No. 4 or at 1.5 MH with respect to luminaire No. 3. Upper diagram shows plane of paper projection of 0.5 MH inclined plane light distribution from luminaire. Comparative interpolation gives pavement brightness produced by each luminaire based upon Reid-Chanon data for asphalt pavement.

shown in the upper portion of Figs. 4 and 5 are normal-to-plane projections of curves shown in Figs. 1 and 2. Dimensions will be to scale including the length of radial lines from the luminaire light center to the points marked off along the roadway line.

The candlepower curves shown in all illustrations are hypothetical having been estimated from the luminaire light distribution isocandle diagram, Fig. 15. This distribution, except for the increase of each candlepower value by 2.5, is the same as the isocandle diagram Fig. 15, Appendix, American Standard Practice for Street and Highway Lighting.[1]

Pavement Brightness Effectiveness

The effectiveness of the luminaire candlepower distribution in providing specific levels of pavement brightness may be judged by comparison with the dash line curves on Figs. 4 and 5 showing the amount of candlepower from the location of the luminaire that is required to produce designated levels of uniform pavement brightness.

The pavement brightness has been calculated from a new iso-pavement brightness diagram based upon longitudinal and transverse roadway distances in multiples of 30-foot mounting height. This new diagram is based on the original Reid-Chanon[4] data on traffic-used asphalt pavement as compiled by J. E. Bock.[5]

It is readily apparent that other candlepower curves similarly plotted in 1.5 MH and 0.5 MH inclined planes may be compared with respective light distributions for desired levels of pavement brightness. Such data, to be made available along representative longitudinal lines, will by interpolation indicate the pavement brightness effectiveness of a specific luminaire light distribution (vice versa for effectiveness of different types of pavement surface).

Linear Pavement Brightness for System

Fig. 6 combines the pavement brightness produced by the light distribution from each of six luminaires along the representative longitudinal roadway line for a distance of 8 MH or 240 feet. With the spacing assumed, the pattern for additional luminaires would be substantially repetitive.

The comparative extent by which each light distribution contributes to the pavement brightness and relative visibility is shown as well as the importance of luminaire placement with respect to the roadway brightness line, the driver-observer path and viewing direction.

The extent by which the light distribution from luminaires No. 4, No. 3 and No. 2 predominate is to be expected and would be increased with sharper cutoff of light at longitudinal distances of 4 to 5 MH from the luminaire. The desirability of proportionately higher candlepower along the 1.5 MH line from No. 3 luminaires is also apparent.

Visibility and Linear Brightness

The effectiveness of the light distribution in providing visibility by pavement brightness is obvious. The arithmetical average of relative visibility is 2.12. This visibility is correlated with the Luckiesh-Moss Visibility Meter.[6] It pertains to discernment of an obstacle having 100 per cent contrast per Reid-Chanon data.[4] The average combined pavement brightness is 0.38 footlamberts with about 0.8 ratio minimum to average.

The same inclined plane method will yield luminaire candlepower distribution and pavement brightness data along other representative longitudinal roadway lines. These may be combined with the above data for an average pavement brightness over the desired roadway width. For example, the 0.5 MH line with respect to luminaires such as No. 3 as viewed from the same 1.5 MH driver-observer path involves different pavement brightness curves, but could use the same 1.5 MH and 0.5 MH luminaire light distribution curves. The pavement brightness along the adjacent-to-pavement longitudinal roadway lines, *i.e.*, 0.5 MH and 2.5 MH requires different inclined-plane candlepower distribution curves as well as pavement brightness curves. Also an assumption is required as to the reflection characteristics of the ground level surface along the adjacent-to-pavement longitudinal lines.

The brightness calculation of obstacles or targets Fig. 17 at locations along the roadway lines involves agreement with respect to reflectance which may be considered typical or representative. This and standardization of target size has already been brought to the attention of several of the I.E.S Committees in progress reports by Professor D. M. Finch.[7] Generally, light distributions which are effective in producing pavement brightness are also desirable in producing obstacles brightness for discernment by surface detail and reverse silhouette. Similarly the linear brightness of portions of the "surround" such as building facades are subject to calculation after assumptions are made with respect to transverse location and reflection. This may be important for visual comfort as well as visibility.

Future comparative evaluations will determine the extent by which the effect of indirect light should be considered as reflected from surfaces such as pavement, sidewalks and buildings.

Seeing Objectives and Eye Level Candlepower

Important additional factors pertaining to the seeing effectiveness of roadway lighting are shown in Fig. 7. This has been prepared[8,9,10] to facilitate understanding of text Appendix Section A, American Standard Practice for Street and Highway Lighting.[1]

Factors such as Luminaire Brightness, Brightness Fluctuation, and Disability Veiling Brightness involve the luminaire light distribution effect on the eyes of the driver-observer. To include vehicle movement, this effect may be depicted by an eye-level longitudinal line parallel with but 4.3 feet[3] above a longitudinal roadway line such as that designated 1.5 MH.

Inclined Plane Distribution to Eye Level Line

There are several evaluation studies[7,11,12] now underway which include appraisal of visual comfort factors and for increased recognition of the advantageous control of luminaire candlepower distributions for restriction of luminaire brightness and disability veiling brightness. To aid these studies, it is recommended that use be made of the inclined-plane-to-eye-level-line presentations of luminaire light distributions. As shown in Figs. 8 and 9 these inclined planes are based upon the longitudinal driver-observer eye-level line. Except for this, these inclined planes are similar to those previously shown and described.

As illustrated in Fig. 10, the longitudinal and

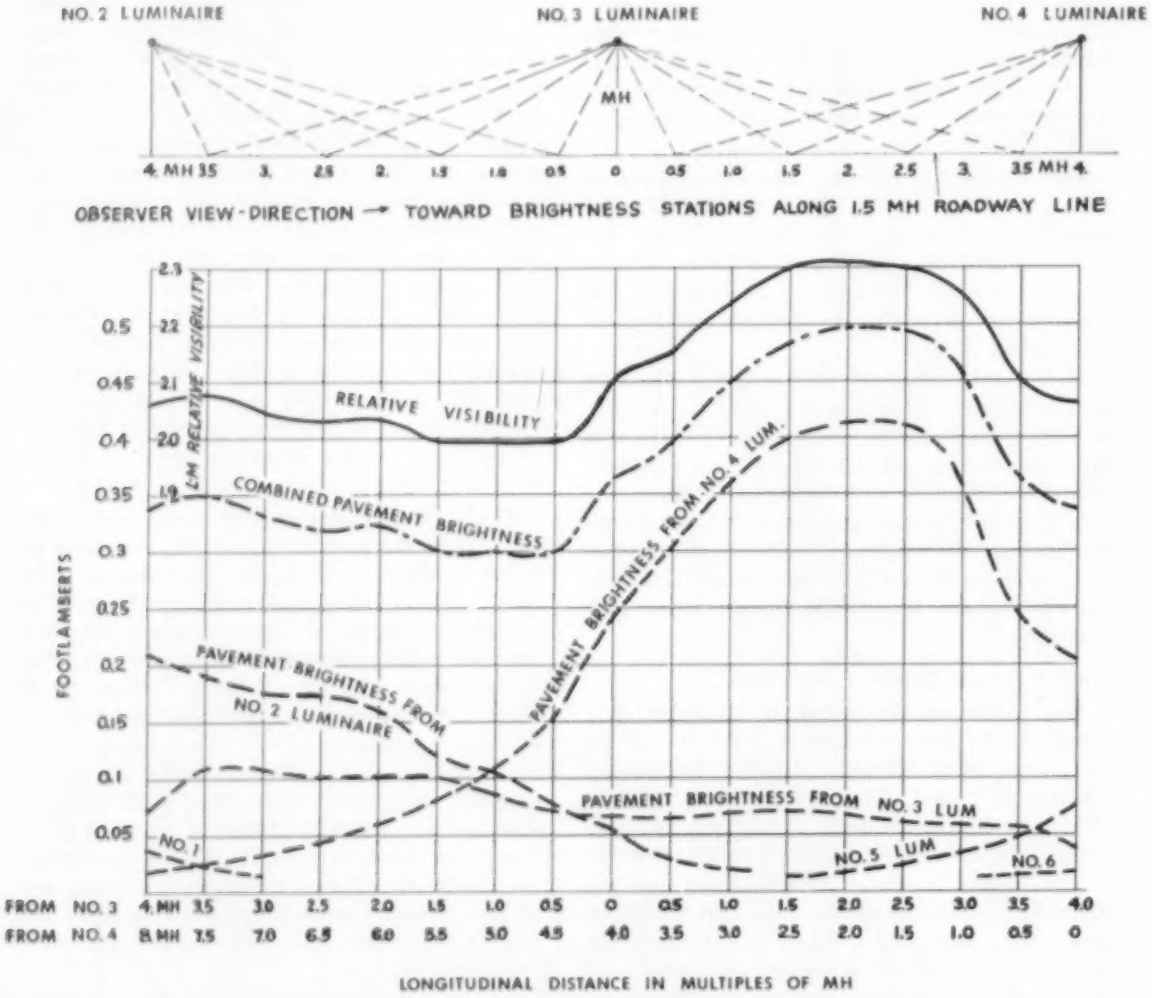
NO. 2 LUMINAIRE
NO. 3 LUMINAIRE
NO. 4 LUMINAIRE
MH
4 MH 3.5 3. 2.5 2. 1.5 1.0 0.5 0 0.5 1.0 1.5 2. 2.5 3. 3.5 MH 4.
OBSERVER VIEW-DIRECTION → TOWARD BRIGHTNESS STATIONS ALONG 1.5 MH ROADWAY LINE
FOOTLAMBERTS
1.M RELATIVE VISIBILITY
RELATIVE VISIBILITY
COMBINED PAVEMENT BRIGHTNESS
PAVEMENT BRIGHTNESS FROM NO. 4 LUM.
PAVEMENT BRIGHTNESS FROM NO. 2 LUMINAIRE
PAVEMENT BRIGHTNESS FROM NO. 3 LUM
NO. 1
NO. 5 LUM
NO. 6
FROM NO. 3 4 MH 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
FROM NO. 4 8 MH 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0
LONGITUDINAL DISTANCE IN MULTIPLES OF MH

Figure 6. Combined system versus component linear pavement brightness along longitudinal roadway line and observer viewing path at 1.5 MH with respect to luminaires such as No. 3 and 0.5 MH with respect to luminaires such as No. 4. Combined relative visibility derived from Reid-Chanon data based upon Luckiesh-Moss Visibility Meter, asphalt pavement and 100 per cent contrast obstacle, luminaires are spaced 4 MH, or 120 feet, staggered.

transverse distances and spacings are similar to and coordinated with the foregoing based upon Fig. 3. The 1.5 MH driver-observer eye-level line for luminaires such as No. 1 and No. 3 is the same as the 0.5 MH eye-level line for luminaires on the observer's right such as No. 2 and No. 4.

If this one line is considered representative of a typical driver's eye-level path, along a roadway layout such as Fig. 10, only the two 0.5 MH and 1.5 MH inclined planes to eye-level will be required for check of candlepower pertaining to luminaire brightness, disability veiling brightness, and fluctuations thereof.

Luminaire Brightness and Disability Veiling Brightness

The single luminaire perspective diagram Fig. 11 may be used to illustrate luminaire brightness and disability veiling brightness calculations as listed in Table I. At the left of the diagram, observer positions *A* and *B* are at longitudinal distances of 6.5 MH and 3.5 MH respectively along the 1.5 MH eye-level line. At the right of Fig. 11, observer positions *H* and *G* are at the same longitudinal distances, 6.5 MH and 3.5 MH respectively, but on the 0.5 MH line.

The luminaire brightness viewed from *H* and *G* is less than that toward *A* and *B* in proportion to the difference in candlepower. This assumes a constant projected illuminated area of the luminaire. Otherwise the brightness would decrease in proportion to an increase in projected area.

The effect of the angles on visual comfort has not

TABLE I — Examples of Luminaire and Disability Brightness Calculations Referring to Figure 11.

Observer Position	A	B	G	H
Longitudinal distance along 1.5 MH line	6.5 MH	3.5 MH		
Longitudinal distance along 0.5 MH line			3.5 MH	6.5 MH
Luminaire Candlepower	2000	9700	3750	1200
Luminaire brightness cd./sq. in. assuming 100 sq. in. proj. area	20	97	37.5	12
D_1—Distance from source (MH)	6.7	3.9	3.64	6.57
D_2—Distance in ft. (30 × MH)	116.8	201	109.3	197.2
D^2—Distance squared	13642	40441	11946	38888
E_1—Footcandles at eye	.049	.711	.314	.0463
θ—Angle, source & sight line (deg.)	14	26	16	8.5
Angle θ to 2.5 power	733	7420	1039	211
Angle θ to 1.8 power	116	350	149	47
Disability veiling brightness foot (lamberts)				
Fry Alpern $\frac{22.4E}{\theta^{2.5}}$	.0015	.00466	.018	.00492
Holladay $\frac{23E}{\theta^{1.8}}$	.0098	.0467	.130	.023
Reduction in Visibility per Holladay and Reid-Chanon data	12	26.5	38.5	19

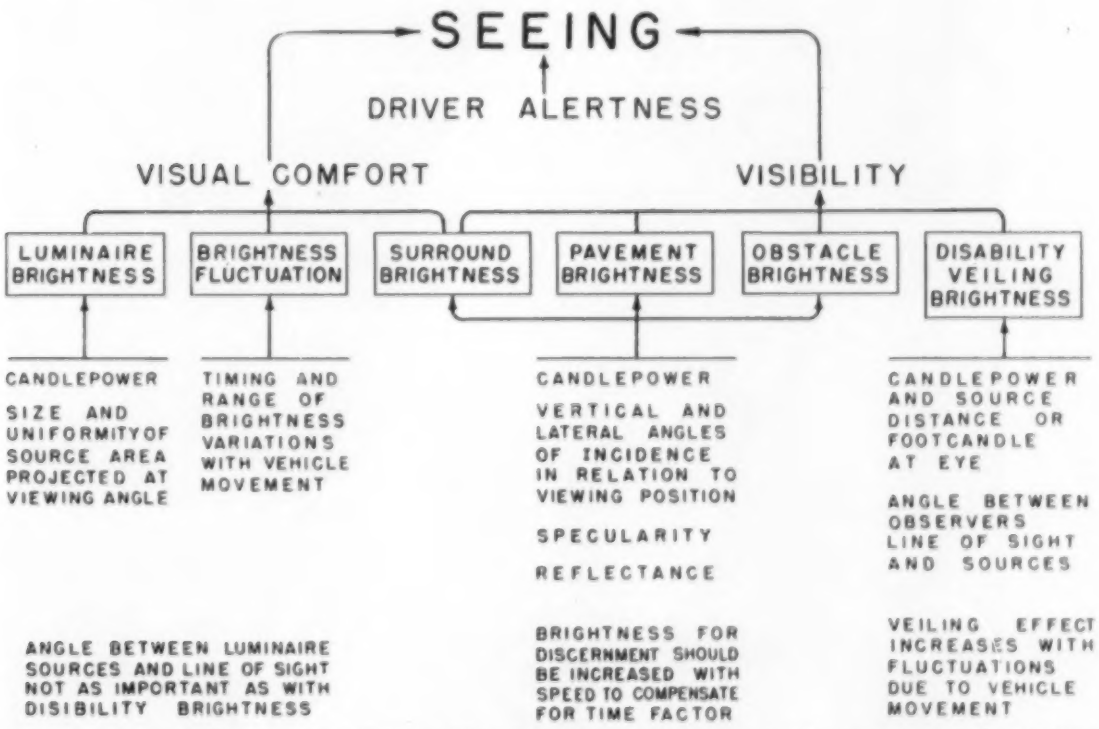
SEEING
DRIVER ALERTNESS
VISUAL COMFORT
VISIBILITY
LUMINAIRE BRIGHTNESS
BRIGHTNESS FLUCTUATION
SURROUND BRIGHTNESS
PAVEMENT BRIGHTNESS
OBSTACLE BRIGHTNESS
DISABILITY VEILING BRIGHTNESS
CANDLEPOWER
SIZE AND UNIFORMITY OF SOURCE AREA PROJECTED AT VIEWING ANGLE
TIMING AND RANGE OF BRIGHTNESS VARIATIONS WITH VEHICLE MOVEMENT
CANDLEPOWER
VERTICAL AND LATERAL ANGLES OF INCIDENCE IN RELATION TO VIEWING POSITION
SPECULARITY
REFLECTANCE
CANDLEPOWER AND SOURCE DISTANCE OR FOOTCANDLE AT EYE
ANGLE BETWEEN OBSERVERS LINE OF SIGHT AND SOURCES
ANGLE BETWEEN LUMINAIRE SOURCES AND LINE OF SIGHT NOT AS IMPORTANT AS WITH DISIBILITY BRIGHTNESS
BRIGHTNESS FOR DISCERNMENT SHOULD BE INCREASED WITH SPEED TO COMPENSATE FOR TIME FACTOR
VEILING EFFECT INCREASES WITH FLUCTUATIONS DUE TO VEHICLE MOVEMENT

Figure 7. Seeing factors in roadway lighting. Objectives such as relatively nominal luminaire brightness, disability veiling brightness and fluctuations with vehicle movement involve control of luminaire candlepower along longitudinal line at driver-observer eye level. Top of automobile windshield cutoff and vehicle speed are also involved. It is assumed that objects to be discerned are of typical size such as a brick, person, or vehicle.

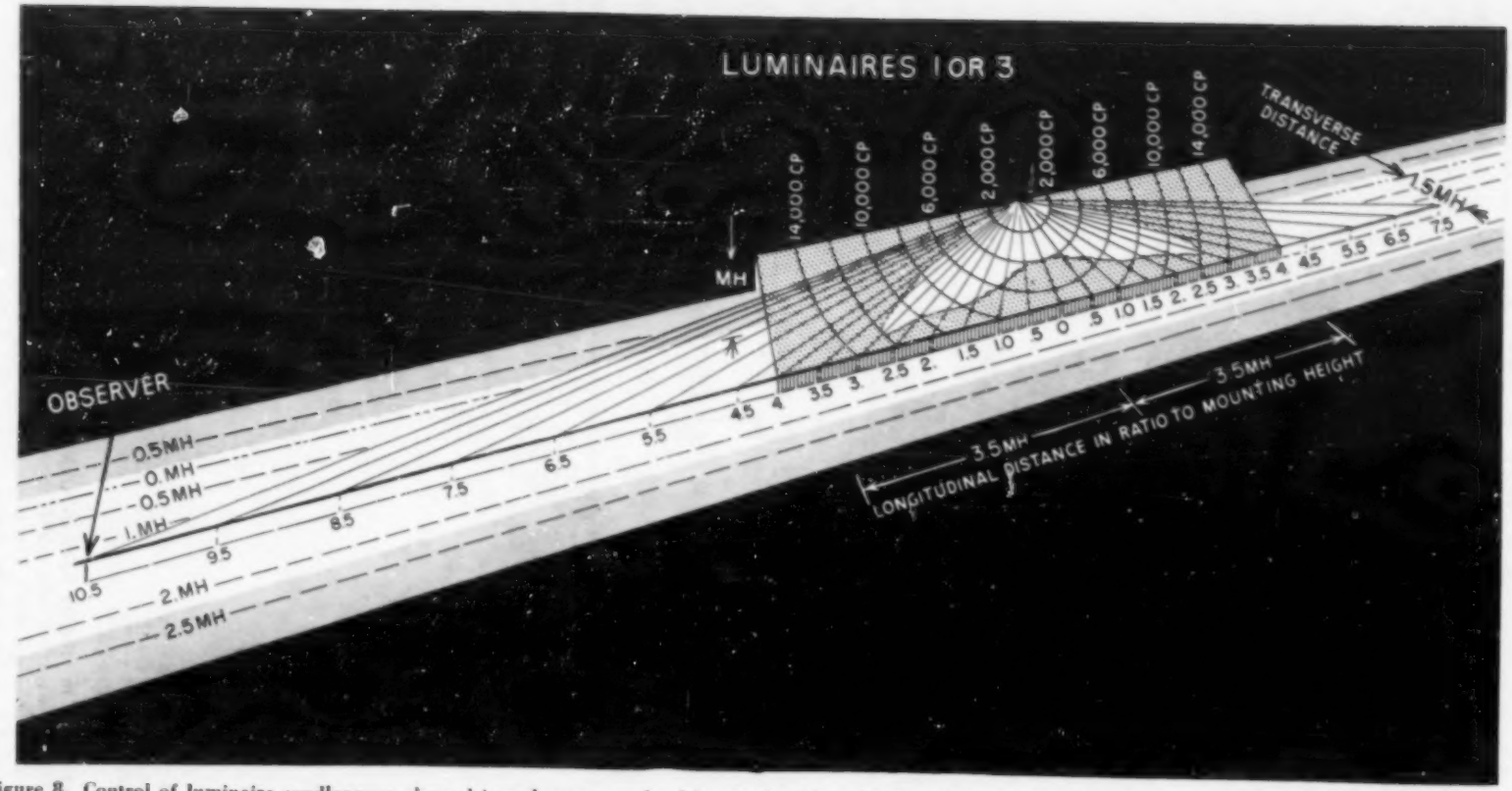

Figure 8. Control of luminaire candlepower along driver-observer eye level longitudinal line 4.3 feet above 1.5 MH line shown in an inclined plane light distribution curve on perspective diagram. Luminaire brightness is proportional to candlepower if projected area is constant. Light distribution curve is from Figure 15.

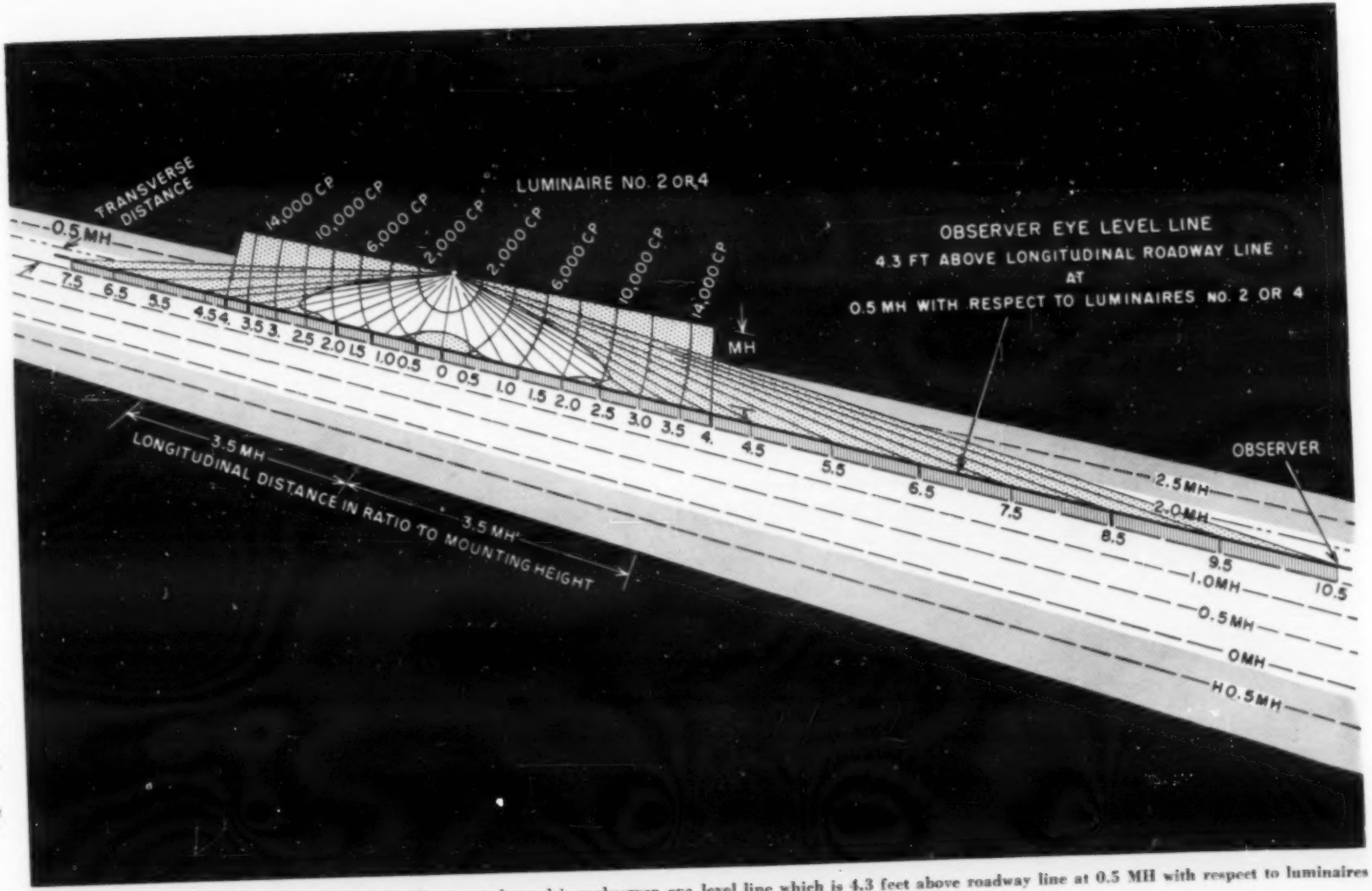

Figure 9. Directional control of luminaire candlepower along driver-observer eye level line which is 4.3 feet above roadway line at 0.5 MH with respect to luminaires such as 2 or 4 and at transverse distance of 1.5 MH with respect to luminaires 1 or 3.

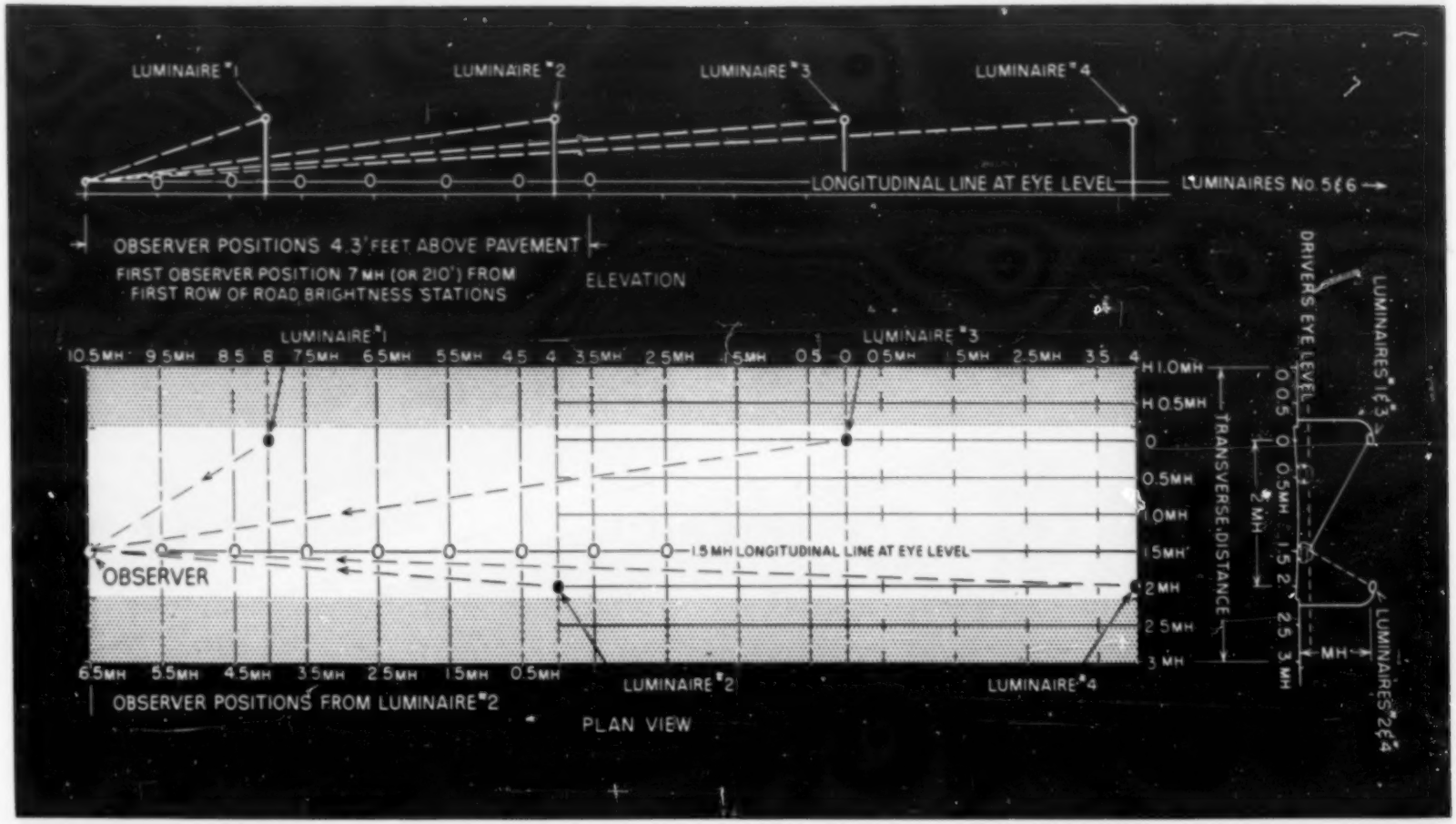

Figure 10. Representative roadway layout showing longitudinal eye level line, driver-observer, positions and luminaire locations assumed for purpose of explanation and calculation of luminaire brightness and disability veiling brightness. Note in transverse section at right that the 1.5 MH eye level line with respect to luminaires such as No. 3 is the same as 0.5 MH line with respect to luminaires such as No. 4.

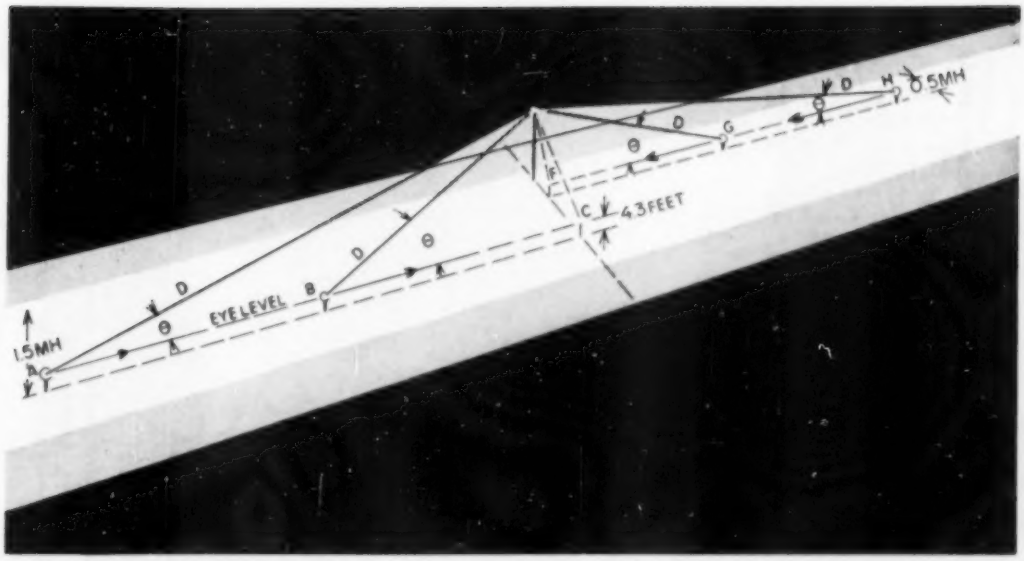

Figure 11. Distances between luminaire and driver-observer eye positions and angles θ with respect to line of sight along longitudinal eye level line at 0.5 MH and 1.5 MH. For data refer to Table I.

been calculated because of lack of data which is known to be applicable to roadway lighting conditions. The best estimates indicate that the threshold of discomfort does not increase uniformly or in proportion to an increase in angle with the line of sight.[13]

In contrast, the disability veiling brightness decreases quite appreciably in proportion to the degree increase in angle raised to the 1.8 or 2.5 power. The difference in exponent depends on whether the Holladay[14] or Fry-Alpern[15] formula is used. In Fig. 11 and subsequent illustrative calculations, the driver-observer line of sight is assumed to be along the eye-level line. As indicated the angles in degrees between this line of sight and the line *D* from the observer's eyes to the luminaire are in the inclined planes.

At comparable longitudinal distances, the disability veiling brightness and loss of visibility along the 0.5 MH eye level line is appreciably higher than that along the 1.5 MH eye level line because of the large difference in angles θ. The per cent loss in visibility is from Reid-Chanon data[4] correlated with Holladay[14] calculations, and the Luckiesh-Moss Visibility Meter.[6] The Reid-Chanon data include the 20 per cent increase found to be caused by the fluctuation with vehicle movement at 25 to 40 miles per hour under representative roadway lighting. It also includes losses due to reflected glare.

Candlepower for Levels of Disability Veiling Brightness

In the upper portion of Figs. 12 and 13 the candlepower curves are shown in projections normal to the inclined plane. In such a plane of paper projection, the angles between the eye-level line and the radial lines to the luminaire light-center are the angles θ mentioned in reference to Fig. 11. The distances along these radial lines will be to scale with respect to the mounting height and longitudinal roadway distances along the eye-level base line.

The candlepower from the luminaire location which will produce the designated uniform levels of disability veiling brightness is shown on the dash-line candlepower curves. This is also shown on the rectangular plot in the lower portion of the diagram.

The approximate 3 to 1 difference in disability veiling brightness along the 0.5 MH eye level line at longitudinal distance such as 9.5 MH and 10.5 MH are to be expected from the difference in the formulas.[14, 15] The angles at these longitudinal distances are about 6 degrees and 5 degrees respectively, exceeding the 4.5-degree limit mentioned with respect to the Fry-Alpern formula. The latter formula has been used advisedly so that its applicability to roadway lighting may be appraised.

Automobile Windshield Cutoff Helps

The large shaded portion of the candlepower distribution shown in Figs. 12 and 13 is assumed to be shielded from the observer-driver view by the top of his automobile windshield. The longitudinal distance of 3.3 MH to a point along the eye-level line has been adopted as a reasonable average approximation representative of 1955 automobiles.[9, 16]

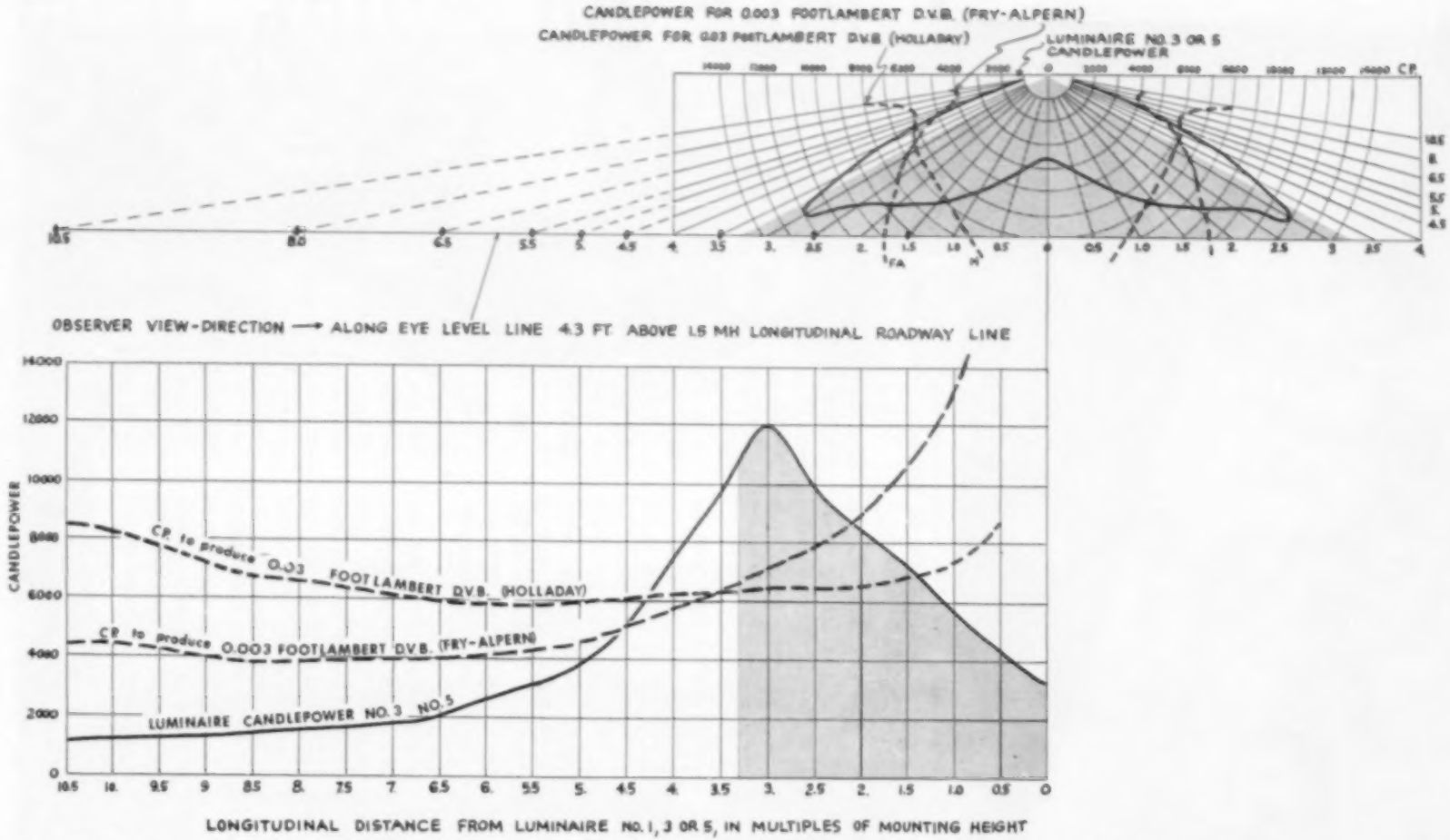
CANDLEPOWER FOR 0.003 FOOTLAMBERT D.V.B. (FRY-ALPERN)
CANDLEPOWER FOR 0.03 FOOTLAMBERT D.V.B. (HOLLADAY)
LUMINAIRE NO. 3 OR 5 CANDLEPOWER
OBSERVER VIEW-DIRECTION → ALONG EYE LEVEL LINE 4.3 FT. ABOVE 1.5 MH LONGITUDINAL ROADWAY LINE
CANDLEPOWER
C.P. to produce 0.03 FOOTLAMBERT D.V.B. (HOLLADAY)
C.P. to produce 0.003 FOOTLAMBERT D.V.B. (FRY-ALPERN)
LUMINAIRE CANDLEPOWER NO. 3 NO. 5
LONGITUDINAL DISTANCE FROM LUMINAIRE NO. 1, 3 OR 5, IN MULTIPLES OF MOUNTING HEIGHT

Figure 12. Candlepower from location of luminaire such as No. 3 which produced designated uniform disability, veiling brightness along longitudinal eye level line at 1.5 MH as calculated from Holladay and Fry-Alpern formulas compared with luminaire candepower which in upper diagram is shown in plane of paper projection of 1.5 MH inclined plane to eye level. Comparative interpolation gives D.V.B. produced by luminaire. The large shaded portion of the candlepower distributions may be assumed shielded from view by top of automobile windshield.

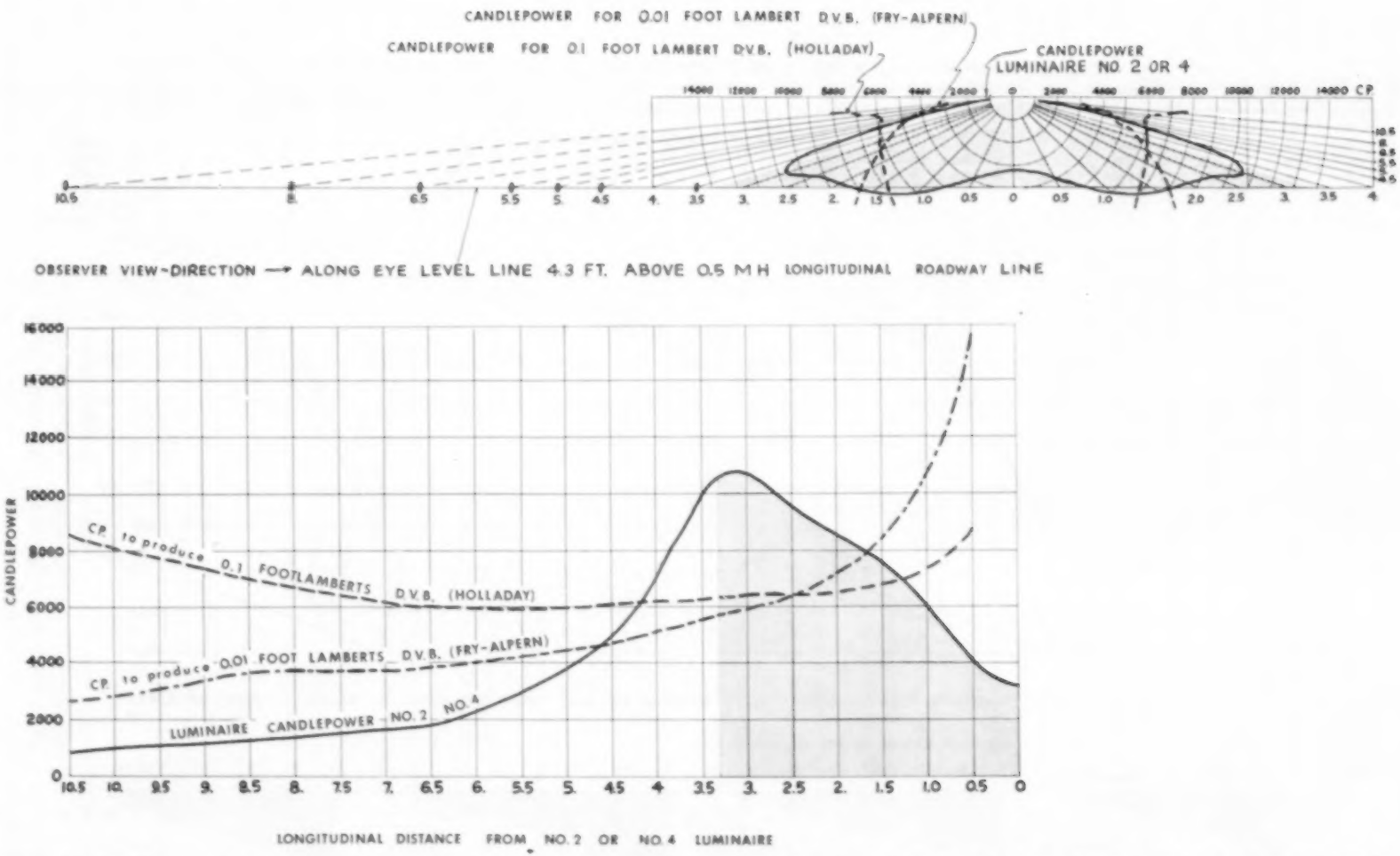
CANDLEPOWER FOR 0.01 FOOT LAMBERT D.V.B. (FRY-ALPERN)
CANDLEPOWER FOR 0.1 FOOT LAMBERT D.V.B. (HOLLADAY)
CANDLEPOWER LUMINAIRE NO 2 OR 4
OBSERVER VIEW-DIRECTION → ALONG EYE LEVEL LINE 4.3 FT. ABOVE 0.5 M H LONGITUDINAL ROADWAY LINE
CANDLEPOWER
C.P. to produce 0.1 FOOTLAMBERTS D.V.B. (HOLLADAY)
C.P. to produce 0.01 FOOT LAMBERTS D.V.B. (FRY-ALPERN)
LUMINAIRE CANDLEPOWER - NO. 2 NO. 4
LONGITUDINAL DISTANCE FROM NO. 2 OR NO. 4 LUMINAIRE

Figure 13. Candlepower from location of luminaire such as No. 4 which produced designated uniform disability veiling brightness along longitudinal eye level line at 0.5 MH with respect to luminaire such as No. 4, or at 1.5 MH with respect to luminaire such as No. 3. D.V.B. calculated from Holladay and Fry-Alpern formulas compared with luminaire candlepower which in upper diagram is shown in plane of paper projection of 0.5 MH inclined plane to eye level. Comparative interpolation gives D.V.B. produced by luminaire. The large shaded portion of the candlepower distributions may be assumed shielded from view by top of automobile windshield.

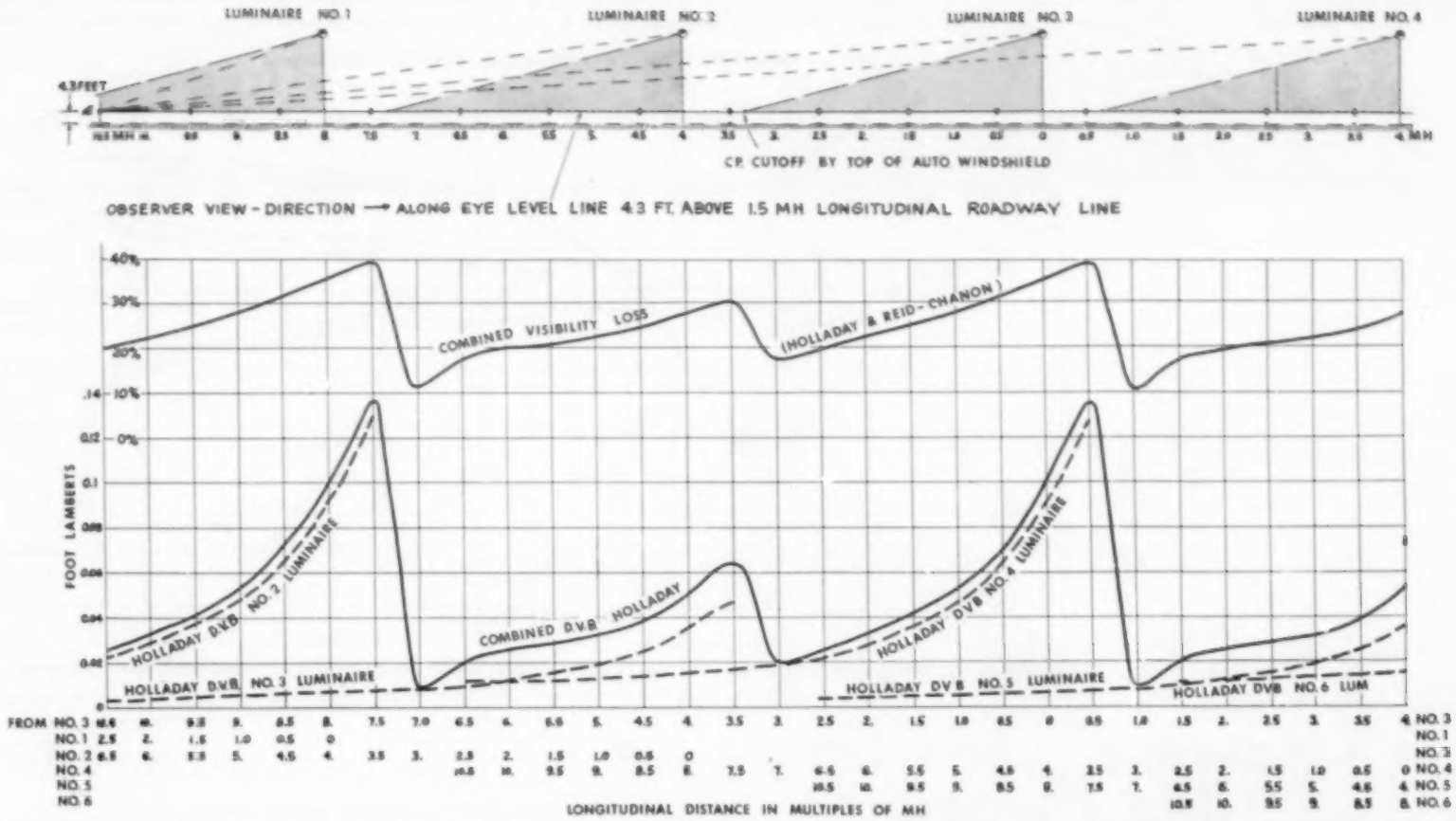
LUMINAIRE NO. 1
LUMINAIRE NO. 2
LUMINAIRE NO. 3
LUMINAIRE NO. 4
4.3 FEET
C.P. CUTOFF BY TOP OF AUTO WINDSHIELD
OBSERVER VIEW - DIRECTION → ALONG EYE LEVEL LINE 4.3 FT. ABOVE 1.5 MH LONGITUDINAL ROADWAY LINE
COMBINED VISIBILITY LOSS
(HOLLADAY & REID-CHANON)
FOOT LAMBERTS
HOLLADAY DVB NO. 2 LUMINAIRE
HOLLADAY DVB NO. 3 LUMINAIRE
COMBINED D.V.B. HOLLADAY
HOLLADAY DVB NO. 4 LUMINAIRE
HOLLADAY DVB NO. 5 LUMINAIRE
HOLLADAY DVB NO. 6 LUM
FROM NO. 3
NO. 1
NO. 2
NO. 4
NO. 5
NO. 6
LONGITUDINAL DISTANCE IN MULTIPLES OF MH

Figure 14. Combined and component disability veiling brightness from light distributions of a system of luminaires spaced 4 MH staggered. Combined visibility loss averaging 26 per cent is from Reid-Chanon data. Veiling brightness from Holladay formula combined along longitudinal eye-level line at 1.5 MH with respect to luminaires such as No. 3 or at 0.5 MH with respect to luminaires such as No. 4. This is correlated with Figures No. 6, No. 3 and No. 10.

Comparison of candlepower to produce certain uniform levels of disability veiling brightness, Figs. 12 and 13 again shows that the problem of control of luminaire candlepower along the 0.5 MH eye level line is about three times as important as along the 1.5 MH eye level line. Comparison with the luminaire candlepower distribution shows the control for restriction of disability brightness which is provided.

According to the Holladay curves, there are only small changes in candlepower for uniform levels of disability veiling brightness over the range of longitudinal distance from 3 MH to 7.5 MH. The angular differences tend to compensate for the long variations in distance. Hence without control, assuming for example a circular candlepower distribution from the luminaire, with the same candlepower at 8 MH as at 3 MH, would mean that the disability veiling brightness and per cent loss of visibility would be the same over this extensive 8 to 3 range of longitudinal distance from the luminaire.

D.V.B. and Visibility Loss from System

The manner in which the disability veiling brightness from each of several luminaires combine in a system is shown in Fig. 14. The spacing is 4 MH staggered[1] as shown in Fig. 10.

The 3.3 MH top-of-auto-windshield-cutoff aids the luminaire light distribution control of candlepower. This results in an appreciably lower average combined disability veiling brightness and per cent loss in visibility from that which the driver-observer would otherwise experience. The Holladay[15] combined average is 0.47 which, according to Reid-Chanon,[4] would account for a 26 per cent loss in visibility.[17]

The predominant disability effect of candlepower from luminaires No. 2 and No. 4 is obvious.

The correlation of data shown in Figs. 6, 14 and 17 with observer and pavement brightness locations shown in Figs. 3 and 10 is of interest. For example, an observer-driver at 7.5 MH, with respect to luminaire No. 3, experiences maximum combined disability veiling brightness while viewing brightness location at 0.5 MH where the combined pavement brightness, Fig. 6, and obstacle brightness, Fig. 17, are low. The pavement or obstacle brightness location is 7 MH (210 feet) ahead of the observer.

Fig. 18 shows the combined net relative visibility for the system using Reid-Chanon data.[4] The visibility is calculated for pavement and obstacle brightness correlated with the disability veiling brightness incurred by the driver-observer. It also shows how the combined pavement and obstacle field brightness weighted 70 per cent - 30 per cent respectively[4] varies with roadway location.

The distance or time cycle between peaks in disability veiling brightness, Fig. 14, is 8 MH (240 feet) or 4 seconds. The effect of such fluctuations on the typical driver-observer, will doubtless be evaluated numerically as well as in terms of overshooting, residual distraction and lag in adaptation for representative roadway lighting systems.

Visual Comfort

Visual comfort evaluations will also doubtless include the effect of flicker or any rapid and large variations in brightness. The luminaire brightness, assuming constant projected area, varies in proportion to the luminaire candlepower shown in Fig. 12 and 13. If the projected area is assumed to be constant at 100 square inches, there is a 7 to 1 range of luminaire brightness. As shown in Fig. 19, the peak distance intervals are 4 MH (120 feet) apart corresponding to time interval of 2 seconds.[1,18] There is some similarity with Fig. 14, disability brightness from luminaires No. 2 and No. 4. The effect upon threshold of discomfort when luminaire brightness is compensated by the larger viewing angles with respect to luminaires such as No. 3 will be interesting. In this connection it is well known that luminaires appear much brighter when driving toward them along the roadway than after a few seconds of steady viewing from a fixed position.

The foregoing involving the dynamics of motor vehicle movement points up the need for an assumption with respect to vehicle speed so that distance may be interpreted in terms of time. The author suggests 2 MH, or 60 feet, per second corresponding to an assumed speed of about 41 miles per hour.[18]

It should be apparent that the suggestions made in this paper will aid in predicting the efficiency of roadway lighting in terms of seeing objectives thus hastening the time at which recommended practice will be based upon seeing factor criteria.

Conclusion

Advantageous principles, proportioning and control of light distributions, the engineering inherent in roadway lighting, and the data for the evaluation of factors in seeing, are of value only to the extent that they are used. Improved presentations will contribute to understanding and more general use of the data which is already available. Agreement on conditions and assumptions which are representative of at least an important segment of streets and highways, will encourage and accelerate future data and developments. Any extra effort that may be involved is small in comparison with the objectives which will be gained. Progress in

increasing the use and seeing efficiency of roadway lighting at a more rapid future pace is essential to the public welfare.

Acknowledgments

The author gratefully acknowledges the day by day, and year by year counsel and assistance of I.E.S. and G.E. Associates. In particular, appreciation is extended to members of the I.E.S. Technical Advisory Committee on Light and Vision, Kirk M. Reid and D. A. Toenjes for counsel with respect to visual comfort factors in seeing and special thanks are extended to J. S. Franklin and his associates, R. G. Hallows and J. Stead, for estimating candlepower values from the isocandle diagram and calculations of disability veiling brightness.

Appendix

The Fig. 15 isocandle diagram has been previously identified. The customary web as described, Appendix B6, page 24 of 1953 American Standard Practice for Street and Highway Lighting, does not include the overlay of longitudinal roadway lines (1) (2) shown in Fig. 15 and Fig. 3. The shaded area Fig. 15 is beyond the roadway area shown in Fig. 3. The unshaded area and the longitudinal lines indicate the portions of the luminaire light distribution which may be most significant.

In order to estimate the candlepower at longitudinal distance points or intervals along the roadway lines shown in Fig. 15, the vertical and lateral angles pertaining thereto can be supplied. Table II provides such information for the H0.5 MH, 0.5 MH, 1.5 MH and 2.5 MH roadway lines.

For the longitudinal distance points along the 0.5 MH and 1.5 MH eye level longitudinal lines which are not shown in Figs. 15 or 16 a similar tabulation of vertical and lateral angles can be supplied. Table II provides such information for eye-level lines at 0.5 MH and 1.5 MH. The angles θ and distances D are also supplied.

Fig. 16 shows longitudinal and transverse roadway lines at pavement level corresponding to the roadway lines in Fig. 3 at intervals of 0.5 MH (2). If the isocandle roadway lines are in color or reproduced on a transparency, they may be applied directly over the conventional isocandle diagram of light distribution lines of equal candlepower. Another better alternative is to provide a web omitting the vertical and lateral angles, comprising only the roadway lines shown in Fig. 16 and plotting the isocandle or lines of equal candlepower thereon to show the light distribution to be presented.

For more accuracy in estimating luminaire candlepower from isocandle diagrams enlargements have been provided allowing closer spacing between lines of equal candlepower.

Also, on the photometer, the candlepower at lateral and vertical angles corresponding to the roadway lines may be read directly. Future photometers may provide automatic recorder curves of the luminaire candlepower along representative longitudinal roadway lines and eye-level lines.

As is doubtless apparent, the isocandle diagrams are not well adapted to showing comparisons such as presented in the foregoing paper.

TABLE II—Angle and Distance Information pertaining to points along pavement-surface and eye-level longitudinal lines.

θ is angle between driver-observer line of sight and the line D from the eye point to the luminaire. Refer to Fig. No. 11.

Longitudinal Distance (MH)	Lateral Angle	Vertical Angles Pavement Level	Vertical Angles Eye Level	Angle θ	D (MH)	D in Terms of M.H.
	0.5 MH Line ("Street Side" or "House Side") Longitudinal Line at Transverse Distance 0.5 MH					
0	0°	26.5°	30.3°	90.0°	29.7	.99
0.5	45	35.3	39.5	63.2	33.3	1.11
1.0	63.5	48.2	52.5	44.8	42.3	1.41
1.5	71.6	57.6	61.5	33.5	54.0	1.79
2.0	75.9	64.1	67.4	26.4	67.0	2.23
2.5	78.7	68.5	71.4	21.7	80.7	2.69
3.0	80.5	71.8	74.3	18.3	94.8	3.16
3.5	81.9	74.2	76.4	16.1	109.3	3.64
4.0	82.8	76.1	78.0	13.9	123.6	4.12
4.5	83.6	77.5	79.3	12.4	138.2	4.61
5.0	84.3	78.7	80.3	11.3	153.1	5.10
5.5	84.8	79.7	81.2	10.3	167.7	5.59
6.0	85.3	80.5	81.9	9.3	182.4	6.08
6.5	85.5	81.3	82.5	8.5	197.2	6.57
7.0	85.9	81.9	83.0	8.1	212.1	7.07
7.5	86.1	82.4	83.5	7.7	227.0	7.57
8.0	86.4	82.9	83.9	7.3	242.0	8.07
8.5	86.6	83.3	84.3	6.9	256.9	8.56
9.0	86.8	83.7	84.6	6.4	271.7	9.06
9.5	87.0	84.0	84.8	5.9	286.5	9.55
10.	87.1	84.3	85.1	5.5	301.4	10.05
10.5	87.3	84.5	85.3	4.3	315.9	10.53

Longitudinal Distance (MH)	Lateral Angle	Vertical Angles Pavement Level	Vertical Angles Eye Level	Angle θ Fig. 11	Distance D (Feet) Fig. 11	D in Terms of M.H.
	1.5 MH Line					
0	0°	56.3°	60.3°	90°	51.8	1.73
.5	18.4	57.7	61.5	73.8	53.8	1.80
1.0	33.6	60.9	64.5	59.8	59.7	1.99
1.5	45.0	64.8	68.0	49.0	68.6	2.29
2.0	53.1	68.1	71.1	40.6	79.4	2.65
2.5	59.0	71.1	73.6	34.6	91.1	3.04
3.0	63.4	73.3	75.7	30.1	104.1	3.47
3.5	66.8	75.3	77.3	25.9	116.8	3.89
4.0	69.4	76.8	78.6	22.9	130.2	4.34
4.5	71.5	78.1	79.7	20.3	144.0	4.80
5.0	73.3	79.1	80.6	18.0	157.7	5.26
5.5	74.8	80.0	81.4	16.3	171.9	5.73
6.0	75.9	80.8	82.0	15.0	186.4	6.21
6.5	77.0	81.4	82.7	14.0	201.1	6.70
7.0	77.9	82.0	83.2	12.8	215.5	7.18
7.5	78.7	82.5	83.6	12.6	230.6	7.69
8.0	79.3	82.9	83.9	11.8	245.2	8.17
8.5	80.0	83.4	84.3	11.2	259.9	8.67
9.0	80.5	83.8	84.6	10.8	274.8	9.16
9.5	81.0	84.1	84.8	10.7	290.1	9.67
10.0	81.5	84.3	85.2	10.4	305.0	10.17
10.5	81.9	84.6	85.4	9.4	319.3	10.64
	2.5 MH Line					
0	0	68.2				
0.5	11.3	68.6				
1.0	21.8	69.6				
1.5	30.9	71.1				
2.0	38.7	72.7				
2.5	45.0	74.2				
3.0	50.2	75.6				
3.5	54.5	76.9				
4.0	58.0	78.0				
4.5	60.9	79.0				
5.0	63.4	79.9				
5.5	65.5	80.6				
6.0	67.4	81.3				
6.5	68.9	81.8				
7.0	70.3	82.3				
7.5	71.5	82.7				
8.0	72.7	83.2				
8.5	73.6	83.5				
9.0	74.5	83.9				
9.5	75.3	84.2				
10.0	75.9	84.4				
10.5	76.6	84.7				

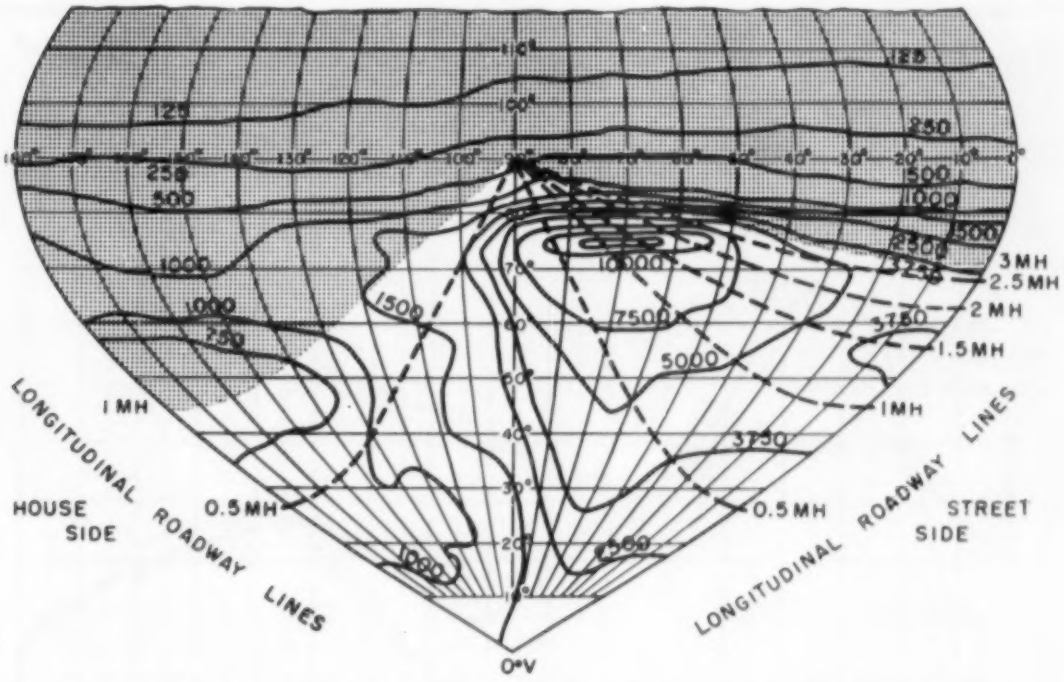

Figure 15. (Appendix) Isocandle diagram of luminaire light distribution used in calculations and illustrations in this paper. This is based upon Figure 15 Appendix American Standard Practice for Street and Highway Lighting except all candlepower values increased in ratio 2.5 to 1. Note longitudinal roadway lines corresponding to Figure 3. Longitudinal eye level lines are not shown.

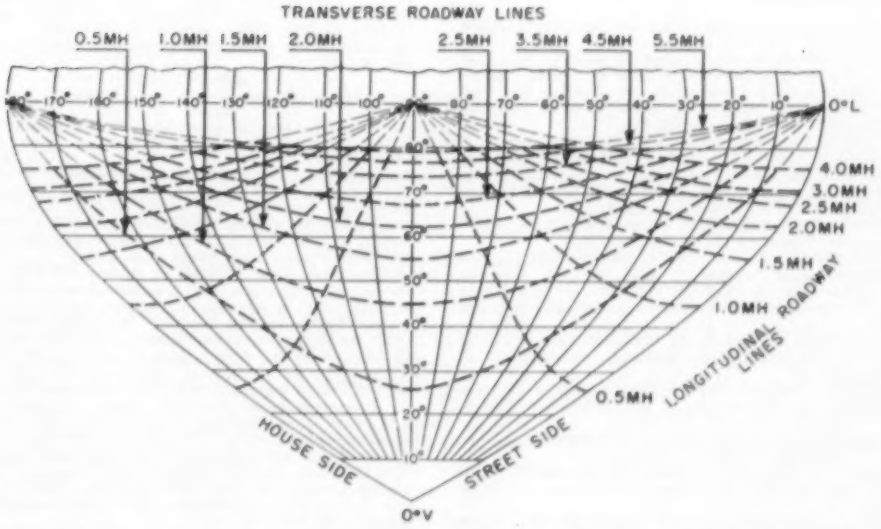

Figure 16. Longitudinal roadway lines and distances in multiples of 0.5 MH as designated by points of interception by transverse roadway lines, superimposed upon vertical and lateral web lines similar to those used for isocandle diagram.

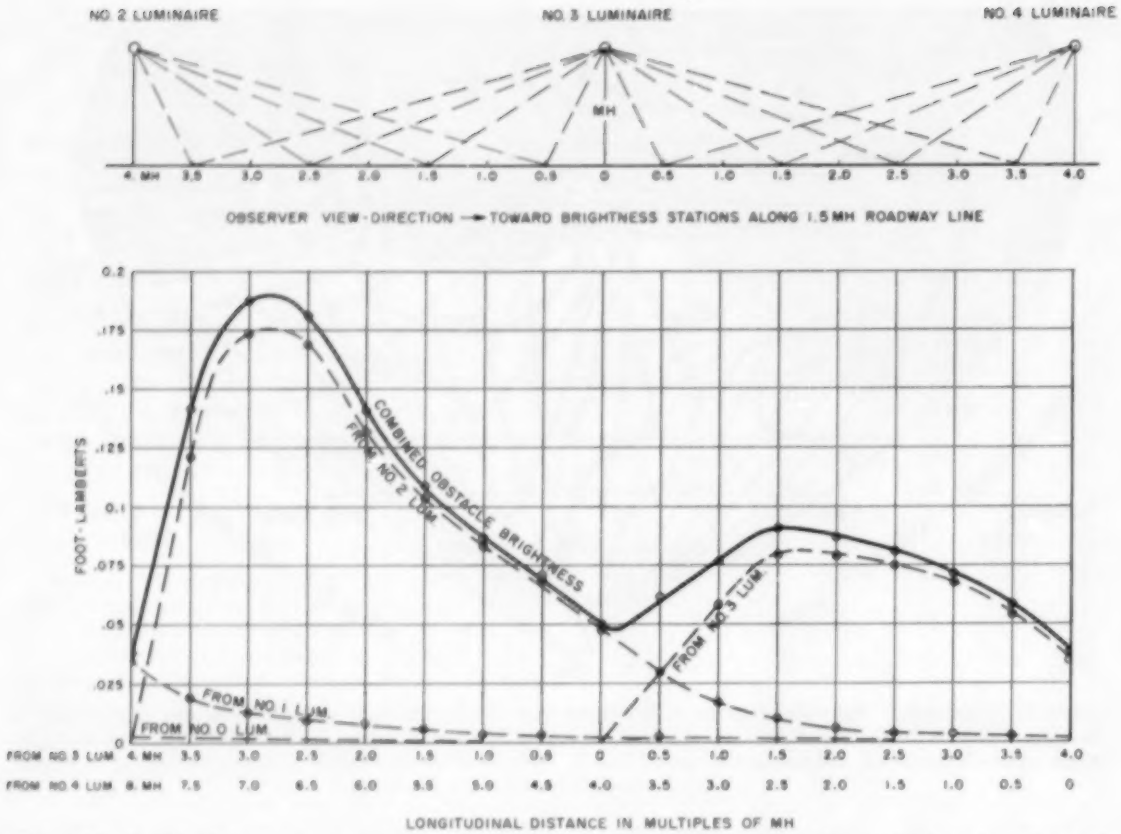
NO. 2 LUMINAIRE
NO. 3 LUMINAIRE
NO. 4 LUMINAIRE
MH
4 MH 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
OBSERVER VIEW-DIRECTION → TOWARD BRIGHTNESS STATIONS ALONG 1.5 MH ROADWAY LINE
FOOT-LAMBERTS
0.2
.175
.15
.125
0.1
.075
.05
.025
0
COMBINED OBSTACLE BRIGHTNESS
FROM NO. 2 LUM
FROM NO. 3 LUM
FROM NO. 1 LUM
FROM NO. 0 LUM
FROM NO 3 LUM 4 MH 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
FROM NO 4 LUM 8 MH 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0
LONGITUDINAL DISTANCE IN MULTIPLES OF MH

Figure 17. Combined system versus component obstacle brightness at locations along longitudinal roadway line and observer viewing path at 1.5 MH with respect to luminaires such as No. 1 and No. 3 and at 0.5 MH with respect to luminaires such as No. 4. The obstacle reflectance is assumed to be 8 per cent.[4] Luminaires are spaced 4 MH or 120 feet staggered per Fig. 3.

References and Footnotes

1. American Standard Practice for Street and Highway Lighting approved February 27, 1953, A.S.A.

2. Footnote: For information with regard to roadway lines and distances in relation to light distributions refer to reprint "Report on American Standard Practice for Street and Highway Lighting" presented at Illuminationing Engineering Society National Technical Conference September 1953, by Charles H. Rex.

3. Footnote: The 4.3 feet above the pavement is based upon 51.7-inch average driver eye height in 25 makes and models of American cars, as of June 1955, according to information kindly supplied by T. J. Carmichael, Engineering Staff, General Motors Corporation Technical Center, Detroit, Michigan.

4. Reid, Kirk M., and Chanon, H. J.: "Evaluation of Street Lighting," ILLUMINATING ENGINEERING, 34, 1939, 1209.

5. Bock, J. E., Report M254498, T6670, Outdoor Lighting Department, General Electric Company.

6. Luckiesh, Matthew, and Moss, F. K.: "Visibility — Its Measurement and Significance in Seeing," *Journal of the Franklin Institute*, 220, 431, 1935.

7. Finch, D. M.: Progress reports on "Investigation of Factors Influencing the Night Visibility of Roadway Obstacles," I. E. Research Project No. 87

8. Rex, Charles H.: "Technical and Practical Aspects of Highway Lighting," *Proceedings of the Institute of Traffic Engineers*, Vol. 8, p. 41, 1937.

9. Traffic Engineering Handbook, Institute of Traffic Engineers, 1941, Section on Street and Highway Lighting.

10. Rex, Charles H.: "Roadway Lighting for Efficiency," paper Annual Meeting Institute of Traffic Engineers, September 11, 1952, Chicago, Illinois.

11. I.E.S. Technical Advisory Committee on iLght and Vision consideration of questions by Research Subcommittee, Fluorescent Subcommittee, and the author, on behalf of I.E.S. Committee, Street and Highway Lighting.

12. Putnam, R. C., and Gilmore, W. F.: Study of Discomfort Glare in Street Lighting.

13. Dr. Glenn A. Fry, June 21, 1955, August 19, 1955.

14. Holladay, L. L.: "Fundamentals of Glare and Visibility," *J.O.S.A.*, 12, 271, 1926 — formula $B = 23E/\phi^{1.8}$ The formulas for candlepower to produce disability veiling brightness, B, are:

Fry Alpern — $CP = \dfrac{B\,D^2\,\phi^{2.5}}{23.4}$ Holladay — $CP = \dfrac{B\,D^2\,\phi^{1.8}}{23}$

15. Footnote: Report sponsored I.E.S Research Fund Project No. 17 by Dr. Glenn A. Fry and Matthew Alpern, ILLUMINATING ENGINEERING, p. 81, January 1955, formula $B = \dfrac{22.4E}{\phi^{2.5}}$ is qualified in the appendix: "It should also be noted that the data presented by the authors are limited to glare angles from 3/4 to 4.5 degrees, and the data presented by Stiles and Holladay and Stiles and Dunbar cover much larger glare angles."

16. Footnote: Data available at present on 1955 cars indicates that the following quote from 1941 edition of the "Traffic Engineering Handbook" is approximately correct according to K. A. Stonex, General Motors Proving Ground: "The angle from the vertical at which the top of automobile windshield cuts off light which would otherwise strike the driver's eyes is about 76 degrees." It should be noted that the longitudinal distanc is to the point at which this angle intercepts the eye level line 4.3 feet above the roadway.

17. Footnote: Recent field tests have been made involving Dr. S. K. Guth, A. A. Eastman, D. A. Toenjes, H. A. Breeding, J. S. Franklin, and the author, using the Luckiesh-Moss Visibility Meter equipped with removable shield for excluding all luminaire light from the meter Relative visibility measurements on representative lighting systems using this meter with and without the shield indicate average per cent losses due to luminaire candlepower in the range of 20 to 30 per cent.

18. The 2MH, or 60 feet, per second assumption based upon 41 miles per hour is a compromise between urban and rural driving speeds. "Reports by 26 states summarized by the U. S. Bureau of Public Roads indicate that drivers traveled on main rural highways in 1954 an average speed of 49.7 miles per hour."

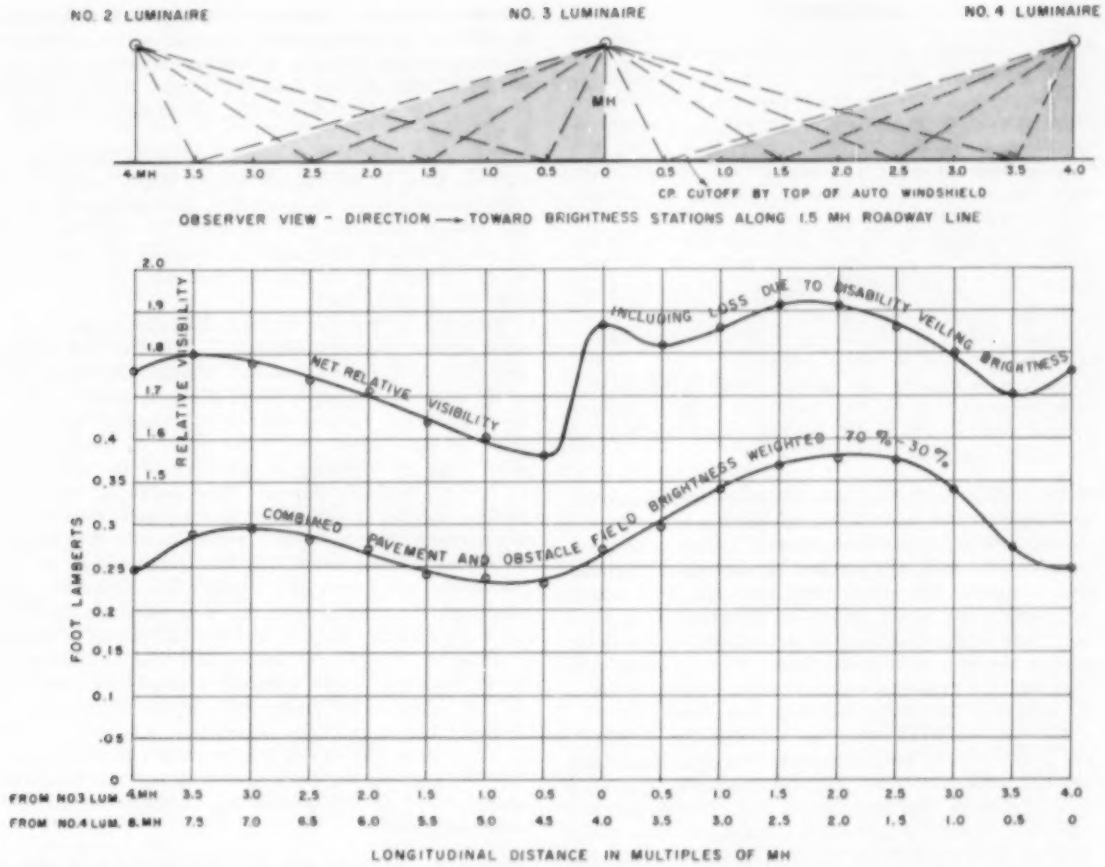
NO. 2 LUMINAIRE
NO. 3 LUMINAIRE
NO. 4 LUMINAIRE
MH
4 MH 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
CP. CUTOFF BY TOP OF AUTO WINDSHIELD
OBSERVER VIEW - DIRECTION → TOWARD BRIGHTNESS STATIONS ALONG 1.5 MH ROADWAY LINE
RELATIVE VISIBILITY
FOOT LAMBERTS
INCLUDING LOSS DUE TO DISABILITY VEILING BRIGHTNESS
NET RELATIVE VISIBILITY
COMBINED PAVEMENT AND OBSTACLE FIELD BRIGHTNESS WEIGHTED 70 % - 30 %
FROM NO.3 LUM. 4 MH 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0
FROM NO.4 LUM. 8 MH 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0
LONGITUDINAL DISTANCE IN MULTIPLES OF MH

Figure 18. Combined system weighted field brightness combining pavement brightness Fig. 6 with obstacle brightness Fig. 17 in accordance with 70-30 percentage ratio Reid-Chanon data. The net relative visibility including loss due to disability veiling brightness, Fig. 14, is derived from Reid-Chanon[4] data based upon Luckiesh-Moss Visibility Meter. Luminaires are spaced 4 MH, or 120 feet, staggered per Fig. 3.

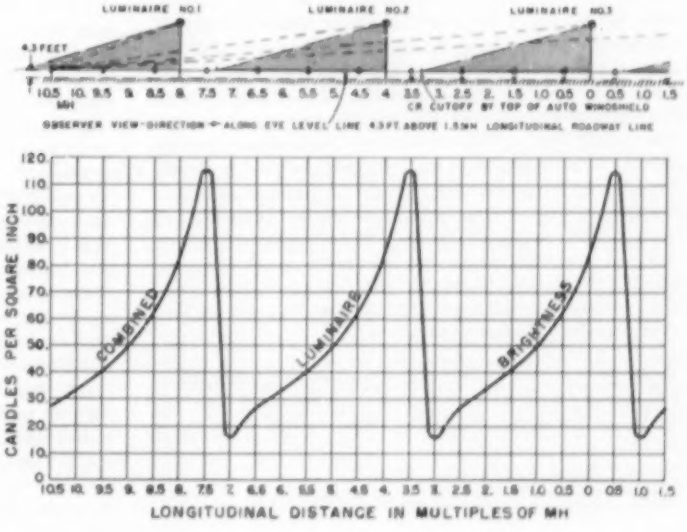
LUMINAIRE NO.1
LUMINAIRE NO.2
LUMINAIRE NO.3
4.3 FEET
MH
CP. CUTOFF BY TOP OF AUTO WINDSHIELD
OBSERVER VIEW-DIRECTION → ALONG EYE LEVEL LINE 4.3 FT. ABOVE 1.5 MH LONGITUDINAL ROADWAY LINE
CANDLES PER SQUARE INCH
COMBINED LUMINAIRE BRIGHTNESS
LONGITUDINAL DISTANCE IN MULTIPLES OF MH

Figure 19. The fluctuation in combined luminaire brightness from a system as the driver-observer proceeds along eye-level line above roadway line at transverse distance of 1.5 MH with respect to luminaires such as No. 3 and at 0.5 MH with respect to luminaires such as No. 2. Candlepower distribution shown in Figs. 12 and 13. Luminaire source area assumed constant at 100 square inches. At some locations as indicated brightness is shielded from view by top of automobile windshield. Luminaires are spaced 4 MH or 120 feet staggered per Fig. 10.

DISCUSSION

HENRY J. CHANON:* I would like to step back for a moment — into a research field in which I have been inactive for some 15 years. The author has made a real contribution to the science of street lighting in presenting a method of appraising street lighting effectiveness on a seeing and visibility basis instead of a footcandle basis. In the future there will doubtless be refinements added to the author's method, or perhaps other methods may be devised.

This work points up the real gains and losses which are directly related to pavement surface characteristics. This, incidentally, is a consideration which was pointed out many years ago as a most important one in any appraisal of street lighting effectiveness, not only by Reid and myself but by other American and European engineers.

We need to simplify such methods. Only then will such basic explorations prove their real value to those who are charged with and who specify the type of lighting required for specific roadways.

W. H. EDMAN**: Mr. Rex's paper is most timely. He should be commended for his effort in presenting a method for dealing with this important subject of luminaire light distributions and their applications. It has been a long time since a paper of this type has been presented and I hope it will lead the way to more papers on the rather complex and much misunderstood concepts of well designed and properly applied luminaire light distributions. It is also significant since there are at present underway several studies by different groups in this country and other countries as well.

Although the calculations are not particularly difficult the presentation in three dimensions of a three-dimensional problem is not easy to do. Any new approaches at this are most worthwhile. The data presented are valuable and much work has certainly gone into its preparation. However, it does not yet seem to be in a form that would be useful to the application engineer, nor do I imagine the author intended it to be so at this time. Hopefully, further studies will develop some practical application tools in this field that will enable the application engineer to weigh all the factors that will be found important in determining greatest visibility distance.

It will be interesting to see a comparison of some of these calculations with similar ones based on the Pavement Surface Reflectance Data being obtained by Professor Kraehenbuehl and the I.E.S. Street and Highway Lighting Research Subcommittee.

As a point of clarification, I am assuming the author does not mean that it is necessarily desirable to use the pavement brightness criterion for all classes of streets. Where high levels of illumination are used, seeing is principally by reflection from, or discernment of surface detail. Here horizontal footcandles seem to be the most practical and satisfactory criterion for prescribing the recommended type of illumination. It is only where we depend principally on silhouette seeing with low levels of illumination, that the horizontal footcandle criterion alone falls short and we need to find a practical method for also dealing with pavement brightness values.

W. B. ELMER:† While this paper contributes an interesting and useful analysis of the problems connected with the design of luminaires for night traffic safety, it does not include a mention or discussion of the principles involved in night-time pedestrian safety. Inasmuch as the usefulness of street lighting generally is fully as important from the pedestrian standpoint as from the driver's standpoint, the content of the paper falls far short of the content promised in the title.

It would seem quite necessary to amend the title in order that the scope of the subject will be clearly conveyed to the prospective reader, as it would be quite possible for anyone seeking information on industrial or home lighting, or anyone seeking information on lighting for pedestrian safety to expect information on these subjects in a paper with this sweeping title.

Referring to Fig. 16 showing longitudinal and transverse roadway lines superimposed upon vertical and lateral web lines, used for the isocandle diagram, the usefulness of the isocandle diagram would be greatly enhanced if all of the longitudinal roadway lines on the diagram were perfectly straight lines. This result could be accomplished quite easily by adjusting the curvature of the coordinate lines of the isocandle diagram. Upon examining the street lighting code for an explanation of the present structure of the isocandle diagram, there is no information discoverable as to the original reason for the present shape of the coordinate curves, which appear upon casual inspection to be sinusoidal. By altering these curves in the proper manner, the whole diagram would be modified and shifted in such a way that any straight line starting at 90 degrees (the center of the diagram) would represent a longitudinal roadway line. Inasmuch as the present shape of the coordinate lines evidently has no particular significance, this change could be made without losing any present feature of the diagram. For the purposes set forth in this paper, this suggested change would greatly improve the usefulness of isocandle dingrams generally.

WARD HARRISON:* In 1951 Reid and Toenjes gave what I think was the first paper on discomfort glare in street lighting. I was gratified to see a consideration of this subject once again on a conference program. It has been my experience over the past twenty-five years that street lighting in Europe is generally more comfortable than in America. Their lamp spacing is on the average much shorter and there is less emphasis on a high angle of maximum candlepower. The British practice digressed for a time when they began to use mercury lamps with their axes vertical. On the other hand their installations of fluorescent lamps are notably pleasing and comfortable. It seems no more trying to look at their fluorescent luminaires than to look at the moon and the public just naturally takes to this kind of lighting.

By contrast much of our incandescent lighting is harsh — to drive under it is like taking medicine — you feel it is necessary to enable you to avoid accidents, but you don't like it. Maybe comfort in street lighting plays a role in reducing accidents also. It is quite true that you may have high visibility and discomfort at the same time or at least you can demonstrate this in a laboratory test where the observer is all attention. On the other hand if it is definitely discomforting to concentrate on the highway ahead, your eyes may decide to relax their vigilance for a moment, and that's when the accident will happen.

I believe there is a great future for fluorescent street lighting in America if it it offered in a way that appeals to the public; when something appeals they will spend liberally for it. I trust that we shall keep the lamp spacing

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*Consulting Engineer, Cleveland, Ohio.

moderate so that the angle of maximum candlepower can be low.

MERLE E. KECK:* In reading or discussing this paper it is difficult to separate the main issues from a multitude of details. It is too easy to discuss the merits or difficulties of the slant plane presentation, and in so doing, tacitly accept the bigger and more important issues which the author states so eloquently without any implication that they are not fundamental truths which no one could dare to question.

The relative value of uniform pavement brightness to visibility in street lighting is a fundamental issue which has never been adequately settled. The American Standard Practice for Street and Highway Lighting is based primarily on uniform horizontal footcandles. The candlepower requirements to produce uniform horizontal footcandles are quite different from those required to produce uniform pavement brightness . In fact, it seems from Kraehenbuehl's[1] data most unlikely that any one candlepower distribution can produce uniform pavement brightness when viewed from more than one observer location. Then, of course, there are those people who feel that uniform vertical footcandles are an important item. Certainly it seems that some support is needed for the author's assumption that pavement brightness is the most important factor.

The author states: "The eyes of the proceeding driver or observer view a succession of longitudinal lines of brightness along the pavement and adjacent area." It is my opinion that the driver views a succession of radial lines of view, with his position as the center of each such set of radial lines.

It is quite true that candlepower distributions can be directly compared as to their merits in producing pavement brightness if we assume constant pavement conditions, and one specific, instantaneous driver-observer position. However, no one, to my knowledge, has ever published or attempted to show the ideal curve so that we may know whether one actual distribution is better or worse than the other. I wish to inquire as to whether the author means to imply that the distribution curve he uses, taken from an appendix of the Standard Practice and multiplied by 2.5, is intended to be, or approach, the ideal curve. It is my understanding that the isocandle diagram in the Standard Practice is for the purpose of showing what an isocandle diagram looks like, and is not intended to represent an ideal curve. It would, of course, be necessary to have an ideal curve for both wet and dry pavement conditions, and various types of pavements, in order to compare the merits of one actual distribution of light over another.

It appears most unusual for the author to base all his pavement brightness data on the iso-pavement brightness diagram of Reid and Chanon, and neglect the much more recent data of Kraehenbuehl[1] which were taken under the IES Research Program as part of the program initiated by the IES Street and Highway Lighting Committee. In determining the calculated pavement brightness, the author apparently assumes that as long as the observer stays on one longitudinal line, that the pavement brightness of any patch of pavement ahead of him, on the same line, will be constant as he draws nearer to it. From Kraehenbuehl,[1] it appears obvious that this assumption is erroneous.

The author makes the statement: "Generally, light distributions which are effective in producing pavement brightness are also desirable in producing obstacle brightness for discernment by surface detail and reverse silhouette." I do not believe that this statement is correct. If we take, for example, a street or highway which carries one-way traffic, the ideal light distribution to produce uniform pavement brightness would direct the majority if not all of its light, toward the driver. On the other hand, a luminaire designed to produce maximum visibility by means of surface detail or reverse silhouette would direct the majority, if not all its light, away from the driver. Certainly these are diametrically opposed to each other.

In the discussion on luminaire and disability glare two facts stand out when this discussion is compared with the first section on pavement brightness. First, is the fact that high candlepower, directed toward the observer, is needed to produce adequate pavement brightness, but that this same high candlepower produces disability glare. Second, is the fact that disability glare is a function of candlepower, and not of luminaire brightness. In other words, a small high-brightness luminaire produces exactly the same disability glare as a large low-brightness luminaire if they produce the same candlepower.

I wish to commend the author for having had the courage to write on such a controversial subject, and I think that we would do well to have papers which convey the reasons behind the choice of a particular type of street lighting distribution.

1. Kraehenbuehl, John O.: "Measurement of Pavement Surface Characteristics," ILLUMINATING ENGINEERING, Vol. XLVII, No. 5 (May 1952).

HAROLD F. WALL:* There has been much discussion in past years about the evaluation of street lighting on the basis of visibility rather than the still accepted basis of footcandles on the pavement as called for in the present American Standard. Mr. Rex is to be commended for his suggestions and his invention of a new form of evaluating photometric data which may enable design calculations to be made from the realistic viewpoint of an observer on the roadway and the pavement brightness patterns the latter sees.

However, several questions and comments have occurred to me, which have not been answered or clarified in Mr. Rex's report. These questions are as follows:

(1) In his report, Mr. Rex made pavement brightness calculations using an "iso-pavement brightness diagram" devised by J. E. Bock in an earlier study. Will Mr. Bock's report be available to others not connected with the General Electric Company?

(2) Obstacle brightness was an important factor in Reid-Chanon data and is only lightly referred to in this report. Does this mean Mr. Rex feels it is not of importance?

(3) The use of visibility methods in street lighting design may prove to be highly effective for dry pavements. Can we use the same methods for wet pavements?

(4) Has relative visibility been calculated using both long and small light sources? If it has, what are the results? Did the light sources show the increased visibility claimed by one manufacturer?

(5) What kind of data will the manufacturer supply with his fixtures for use in this type of calculation?

(6) Can some factor for footlamberts of glare be arrived at which can be subtracted from pavement footlamberts in order to obtain a true measure of visibility? If not, how can the relative effective illumination of two physically different types of lighting systems be compared using Mr. Rex's methods?

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*174 E. Atwater St., Detroit, Mich.

JOHN W. YOUNG:* This paper puts forth in a compact form the several light distribution principles concerned with the applying of roadway lighting for seeing effectiveness. The presentation is handled with knowledge of the elements involved and the background material, likewise foresight in stating the conditions, assumptions and data yet to be established. Commendation is due Mr. Rex for a stimulating contribution that gives a new lift to those engaged in applying roadway lighting.

As is expressed, lighting for efficient and effective seeing concerns more than merely "average footcandles" on the street; it involves control of brightness values, including getting brightness in the right places as much as anything.

By the full and proper use of the candlepower curves, the method suggested should result in obtaining better tailoring of light patterns on the street. Observations that might be made in this connection are: It is apparent that two or more distributions can be compared directly as to suitability with the data derived by the isocandle diagram and plotted along the roadway lines; modifications of or entirely new candlepower distributions can be appraised for specific roadway conditions. Such comparisons might be expanded to include significant variations that may exist with the three prevailing types of light sources — filament, mercury vapor, fluorescent — and their luminaires. Discussion by the author on this latter point would be appreciated.

There is a further observation from the application engineer's standpoint; comprehension of the principles of applying lighting is needed more now than at any other time past and future in dealing with the wide variety of roadway conditions that prevail. Situations that might be cited are numerous — freeways and expressways, underpasses, dual highways, residential streets that rate as vehicular traffic streets, high lumen lighting on unusually narrow streets, proper dealing with "back lighting" of roadway adjacent areas, buildings and structures, problems in grades and curves, and others.

A good first move might be to analyze present lighting to determine the existence of opportunities for realizing even more effective light distribution. As pointed out, the engineering of roadway lighting will be successful only to the extent that the fundamentals are followed and the data are used. Merited lighting is attainable by giving full attention to the measurable factors and experience data available to the engineer; thus improved visibility and seeing comfort will be assured the user of the street, vehicle drivers and pedestrians alike.

CHARLES REX:** The discussion comments are most welcome and appreciated. Here once again is proof of interest in good seeing conditions. The first and foremost principle of light distribution control and proportioning is that efficient seeing be provided. If this paper does nothing more than aid in delineating the problem of seeing evaluation it will have been worthwhile.

As Mr. Chanon indicates, methods for appraisal of street lighting effectiveness on a seeing and visibility basis should be improved and understood so that they will be used by those charged with the specification of lighting. Use of roadway lighting and the resultant improvement in seeing for night use of our transportation investment are of public significance.

To further this objective, G. K. Glass, Chairman of the IES Committee on Street and Highway Lighting has recommended the appointment of a small working subcommittee on Roadway Lighting Principles. Our first report will pertain to methods for presentation of luminaire light distribution data so that candlepower performance may be readily appraised in terms of at least some of the factors in seeing. Later reports will present methods for specification of desired levels of seeing.

The discussion by Mr. Edman and others prompts me to call attention to the following quotation from the first sentence of this paper. "Modern roadway lighting practice involves luminaire light distributions which are controlled and proportioned to provide efficient seeing."

Mr. Edman mentions the misunderstandings with respect to the concepts of well designed and properly applied luminaire light distributions. If we do not show the "how" and the "why" and the "so what" of luminaire light distributions such lack of understanding may prevail for a long time to come. Practical methods of presenting our principles is essential and of considerable significance in the development of both principles and distributions.

Inclined plane candlepower curves provide a means of comparison of that which we have with that which we know to be good. Representative roadway lines and driver paths materially reduce the complexity of the problem. Although the light distribution used for the comparisons in this paper is hypothetical it has characteristics which to a greater or less degree are typical of roadway lighting luminaires in use today. It was adopted for practical reasons, for comparison with the types of distribution which be required for uniform pavement brightness, for alleviation of the adverse effects of disability veiling brightness, etc. The best available data were used. The comparisons show how, why and to what extent modern light distribution principles are of benefit in producing good seeing conditions.

The limitations of other methods now in use are known and mentioned in the American Standard Practice for Street and Highway Lighting.[1] Candlepower distributions in the vertical planes of maximum candlepower, or cone of maximum candlepower, from luminaires for side of road mounting (*i.e.* providing Type II, III, or IV lateral widths) intercept any one of the respective roadway lines or driver paths at only two points. Data at two points from such curves are of only partial value. As stated in the paper, even isocandle diagrams are not practical for the comparisons considered essential to this paper.

As Mr. Edman says it will be of interest to see how closely the Reid-Chanon and Krachenbuehl data agree on comparable pavement samples. This will be delayed until the latter, Krachenbuehl, data are available in usable form. Note that we suggested that the inclined plane and representative roadway line method might be used as a practical means of presenting the "effectiveness of different types of pavement surface."

Mr. Edman's point of clarification can best be answered by saying that the seeing and visibility criteria should apply even when discernment is not principally by silhouette. Refer A-2.2 and A-2.3, page 19 of the American Standard Practice for Street and Highway Lighting. The brightness on the sides of the object toward the driver and the uniformity thereof when positioned at representative locations along the roadway, and along adjacent areas, is obviously a function of the impinging candlepower. An appropriate method of answering the question is to assume the conditions which Mr. Edman has in mind and compare the brightness results obtained with several variations in the proportioning of light distribution candlepower.

*New England Power Service Co., Boston, Mass.
**Author.

The Fig. 17 illustration for use of the inclined plane method of presenting obstacle brightness has been prepared since publication of the preprint. It and Fig. 18 should help answer some of the questions also mentioned by other discussors.

The importance of the obstacle brightness factor in visibility is well known as indicated in Fig. 7 of the paper. To indicate the advantages of the inclined plane and representative longitudinal lines method of appraising light distribution performance mention may be made of the following: Under the bumper to bumper traffic condition which Mr. Edman may have in mind the most significant object brightness may be at or near eye level. Hence the inclined-plane to eye-level candlepower curves might be more suitable than the candlepower distribution extending down to lines along the pavement surface. Usually, however, the latter curves should be used. The Reid-Chanon 8 per cent reflectance obstacle was one foot in diameter with center one-half foot above the pavement. The center of the 11 per cent reflectance obstacle used by Professor Finch is only nine inches above the pavement.

It is not clear whether Mr. Elmer's comment refers to the discernment of a pedestrian by a motorist or refers to the pedestrian as an observer. Certainly the principles of light distribution for seeing and visibility apply to objects such as pedestrians. Perhaps the foregoing discussion of obstacle brightness was desired. The pedestrian as an observer might not be equipped with eye shielding equivalent to the top of windshield cutoff which the automobile provides for the driver. In such instances the pedestrian might be more subject to luminaire brightness and disability veiling brightness while crossing the roadway.

If Mr. Elmer's concern is with regard to the visibility of or for a pedestrian observer walking along the adjacent to roadway area, or a sidewalk, many of the brightness factors may be calculated and the effectiveness of light distributions compared.

A longer title for this paper including the words, roadway lighting, could have been adopted by the Papers Committee. However, the paper was presented during the Street Lighting Session at the Technical Conference. Let's hope that those having other interests will not be too annoyed. Perhaps they might be just a little interested.

The balance of Mr. Elmer's discussion is apparently in agreement with the Paper, Appendix, fourth paragraph, third sentence.

Dr. Ward Harrison's comment will help direct increased attention to seeing comfort. This is "one of the most important ingredients in lighting which will make night driving more pleasant, convenient and attractive. That is what we need to appreciably expand the use of roadway lighting." The reader should not infer that recognition of the importance of comfort has only occurred during recent years. The 1937 I.T.E. paper[8] makes numerous and emphasized statements as to the importance of comfort, discomfort and seeing. The 1941 Traffic Engineering Handbook[9] also shows considerable recognition of this highly important comfort factor in roadway lighting. Also the American Standard Practice, Section A-2.6.2.

It is hoped that Mr. Keck will continue to question the relative importance of the factors in seeing. His conclusions will doubtless be based upon discussion, analysis, and evaluation of the best available data and experienced opinion. This paper should aid him in that endeavor.

The American Standard Practice for Street and Highway Lighting[1] should be consulted more extensively than Table IV which recommends average not necessarily uniform horizontal footcandles. To quote: "The lowest footcandle value at any point on the pavement should not be less than one-fourth the average value given in Table IV." 3.5 "These footcandle values assume compliance with the recommendations on light distribution, mounting height, spacing, and size of lamp." . . . 2.1 "Proper distribution of the light from luminaires is one of the essential factors in efficient roadway lighting. The light emanating from the luminaires is directionally controlled and proportioned in accordance with the requirements for seeing and visibility described in Appendix A."

The latter Appendix A was the basis for Fig. 7 as the paper states. Fig. 7 shows six of the important factors in seeing. Pavement brightness, one of these factors, was used as one of the examples in this paper. Mr. Keck's question as to whether pavement brightness is the most important factor can best be answered by his own investigation based upon his assumptions with respect to conditions. The latter could vary over a wide range.

The question as to whether the areas which the driver views could be shown better by "a succession of radial lines" can best be answered by Mr. Keck trying it. The word "succession" along the roadway is significant in this respect.

The Reid-Chanon data is based upon a series of driver-observer viewing positions rather than one. The light distribution used in the paper was chosen as having typical characteristics for reasons similar to its selection for the Standard Practice isocandle diagram.

"Ideal" curves for wet and dry pavement conditions and various types of pavement may be desirable but not necessarily requisite for progress. A clear understanding of objectives and even exemplary light distribution curves develops from studies such as this paper presents. Use of the Kraehenbuehl data and comparison with Reid-Chanon data will follow. The erroneous assumption which Mr. Keck attributes to the author did not and does not exist. This, Mr. Keck will realize by reading the paper and the Reid-Chanon reference.[4]

Mr. Keck's one-way traffic street and unidirectional light distribution exception to our generalization represents an exceptional condition. However, the conventional types of light distribution are often used on one-way streets for the purpose of providing obstacle brightness as well as pavement brightness. Refer to previous comments, Fig. 17, Fig. 18.

Mr. Keck's closing statement with respect to information gleaned from the paper is heartening. If the "choice of a particular type of street lighting distribution" has not been already explained to his complete satisfaction I hope that he will consult with members of the Committee on Street and Highway Lighting and convey to me his suggestion as to a distribution which might have been better, bearing in mind the objectives of the paper.

Mr. Wall's "however" with which he prefaced his list of questions at the Cleveland Conference was uttered with great gusto and emphasis. It is unfortunate that it cannot be conveyed to the readers. I particularly regretted that there was not any time allowed for response answering the following questions:

(1) Iso-pavement brightness diagrams based upon Reid-Chanon data are available based upon driver observer path along the 1.5 MH and .5 MH longitudinal roadway lines for traffic-used asphalt. Other diagrams will be made avail-

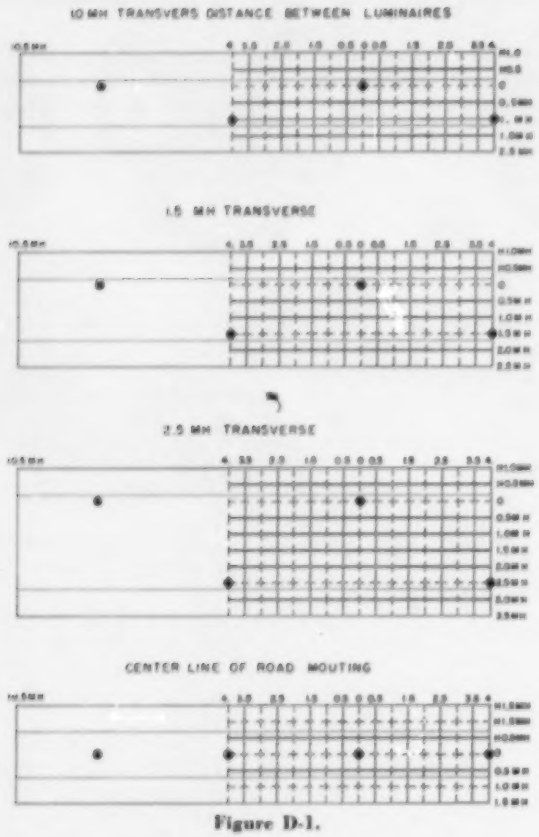

Figure D-1.

able subject to the usual practical limitations with respect to time.

(2) The question regarding obstacle brightness has been previously answered.

(3) Wet pavements, to varying degrees of wetness, seem to present special problems. However, the condition prevails with such frequency and often produces such hazards as to warrant special attention. Let's hope that we will soon have more data on seeing and visibility under wet pavement conditions.

(4) Calculated comparison of seeing and visibility using both long and small light sources has not, to my knowledge, been made.

(5) The manufacturer will wish to provide the data desired, such as candlepower distributions in inclined planes to representative longitudinal roadway lines and driver-path eye-level lines.

The adaptability of roadway lines at 0.5 MH intervals to various street widths or transverse distances between luminaires is shown in Fig. D-1.

Mr. Wall can help by giving his opinion as to how much data he needs, including observer-driver paths.

(6) Mr. Wall's sixth question can best be answered by saying that we will endeavor to more directly correlate field brightness of pavement and/or obstacle with (D.V.B.) disability veiling brightness and the other factors in seeing. This is the job ahead. I most certainly believe that it can and will be done. It should be noted here that this paper and other studies show that the present day proportioning and control of light distribution is much more effective in accomplishing the objectives than would be the case if the objectives, principles, and factors in seeing were not recognized.

Mr. Young's discussion also represents a substantial contribution. He will be a participant in the activity which will produce the answer to his question regarding type of light source and size of luminaire. With the Fluorescent, and Research Subcommittees, and the Technical Advisory Committee on Light and Vision working on the problem an answer should be forthcoming soon.

As stated in the presentation at Cleveland, let's be optimistic. Let's hope that the often repeated desire for roadway lighting on a seeing and visibility basis is a case of our crying with a loaf of bread under one arm and at least a half a loaf of comfort under the other.

[References in the author's rebuttal are to those in the paper. See page 606.]

Watch for the January Issue

Next month's issue of ILLUMINATING ENGINEERING will be twice its usual size. Reason: a special issue to commemorate the Society's 50th birthday. Watch for your copy — it will be a book every member will want to keep.

INSTALLATION IN ROCHESTER, N. Y.

Luminous Ceiling in a Remodeled Kitchen

LIGHTING OBJECTIVE: To provide recommended levels of general lighting and local illumination at the range, sink and work areas in a kitchen, with a minimum of rewiring.

GENERAL INFORMATION: The kitchen is approximately 12 feet x 11 feet 6 inches with a 9-foot ceiling. The ceiling is painted white (80 per cent reflectance); the work counters are a pearl gray formica (60 per cent reflectance); the cabinets are light green (50 per cent reflectance); the floor has a spattered beige linoleum (40 per cent reflectance).

INSTALLATION: This Acusti-Luminus ceiling is lighted by six 96-inch T-12 and two 48-inch T-12 standard cool white 425 ma slimline fluorescent lamps spaced as shown in Fig. 2. The lamps, located 10 inches above the plastic ceiling (50 per cent transmission factor), are mounted on a

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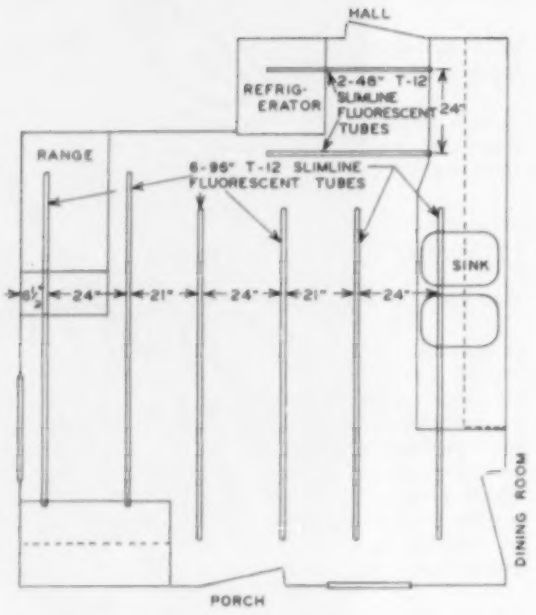
Luminous Ceiling in a Remodeled Kitchen (Continued)

Figure 2. (right) Plan view.



grid type channel system (catalog no. LC-AS 296 and LC-AS 248) which is fastened to the structural ceiling. The channels and plastic ceiling are manufactured by Luminous Ceilings, Inc., Chicago, Illinois.

Illumination measurements taken after four months' use were as follows:

Center of range	65 ft-c
Center of sink	65 ft-c
Center of work counters	65 ft-c
Center of room (30" above floor)	75 ft-c

The brightness of the ceiling varies between 120 footlamberts and 230 footlamberts. The owner plans to change from standard to deluxe cool white slimline fluorescent lamps to improve the appearance of food, complexions and room colors. It is estimated that this will reduce the level of illumination to an average of approximately 45 footcandles, which is still above the recommended practice.

Lighting designed by Walter Parkes, T. H. Green Electric Co., Inc., 31 N. Water St., Rochester, N. Y.

Lighting data submitted by Melrose Franklin, Home Lighting Consultant, Rochester Gas and Electric Co, 89 East Ave., Rochester, N. Y., as an illustration of good lighting practice and to aid in the design of similar installations.

Published by the Committee on Publications of the Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

Graphical Determination of Illumination By Solid Angle Projection Methods

(Discussion of paper by John O. Kraehenbuehl, published in November 1955 issue of ILLUMINATING ENGINEERING)

ROBERT S. WISEMAN:* I wish to compliment Professor Kraehenbuehl for his excellent and concise presentation of a method which has very useful applications. I should like to add to his presentation by describing a graphical method which I have used satisfactorily to obtain the angles α and β for plotting the projected area.

Fig. 1 shows the "angular-rectangular" graph paper constructed for this method. Consider a spacial point A, $x = 4$, $y = 3$, $z = 7$, which is on the periphery of a surface source. This point is located on "Sheet 1," Fig. 1, by projection directly onto the x-y plane (plane being illuminated). This would be the plan view of a surface if the illumination is received on a horizontal plane. The angle β can be read directly from the radial lines as 36.9 degrees.

"Sheet 2," Fig. 2, is prepared by drawing a line parallel to one axis, *e.g.* P_2V_2, and at a distance from the axis equal to the height of point A above the plane. Thus, point A is somewhere along the "line of A" which is located seven units from the reference axis P_2V_2. The same scale must be used for both "Sheet 1" and "Sheet 2."

"Sheet 2" is now folded along the reference axis and placed over "Sheet 1," Fig. 3, so that P_2 and P_1 coincide. A pin may be used to keep these points together and permit "Sheet 2" to rotate about P_1P_2. "Sheet 2" is now rotated until the reference axis, P_2V_2, coincides with the radial line from P_1 to A_1. A perpendicular from point A_1 on "Sheet 1" to the "line of A" on "Sheet 2" locates the point A_2 on this line. The radial line from P_2 to A_2 indicates the angle α, 54.4 degrees.

These angles, β and α, are then used to locate point A_3 on the orthographic polar projection, Fig. 4.

If the boundary of the source is in a plane parallel to the plane being illuminated, one line on "Sheet 2" will contain all the points of the periphery. If the plane of the boundary is oblique, an auxiliary projection may be used to find the "lines of A" on "Sheet 2." In practice, it is simplest to select the points to be located as the corner or limit points and those located by the intersection of the 5 or 10 degree β lines with the periphery as drawn on "Sheet 1."

Problems outlined in Table I, have been solved by using the graphical method for determining the angles and these angles were then plotted on an orthographic polar projection

*Chief, Research and Photometric Section, Night Vision Equipment Branch, Electrical Engineering Dept., Engineer Research and Development Laboratories, Fort Belvoir, Va.

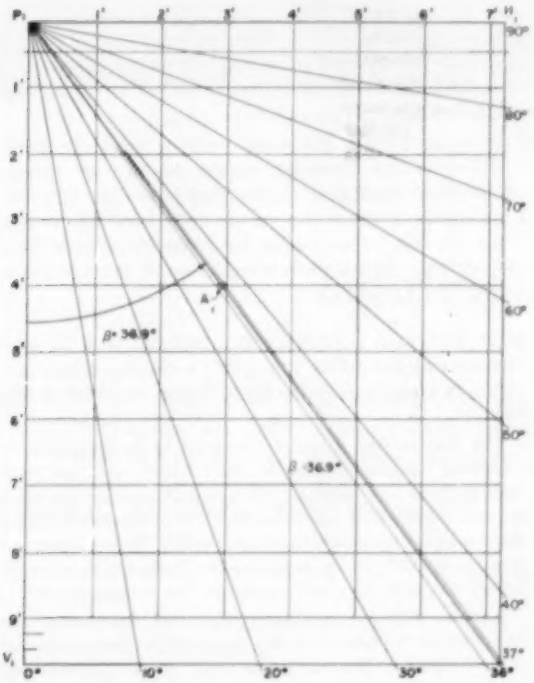


Figure 1, Wiseman. Sheet 1 — graphical determination of β by locating the projection of the spacial point A (4, 3, 4) on the x-y plane.

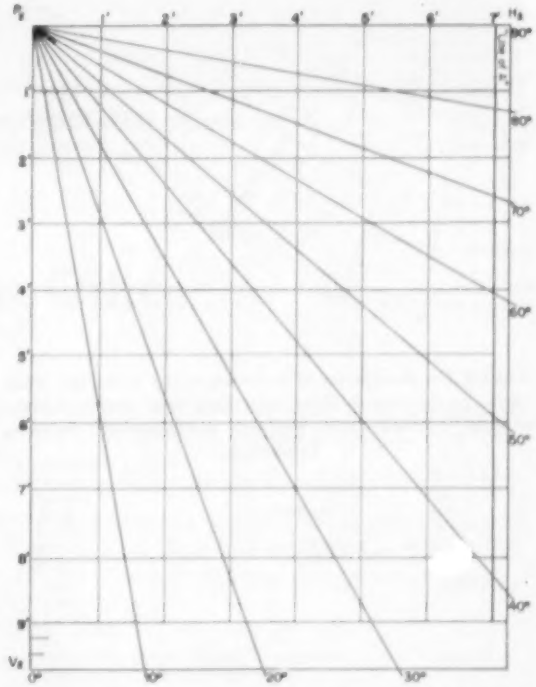


Figure 2, Wiseman. Sheet 2 — "line of A" indicates distance between A and the x-y plane.

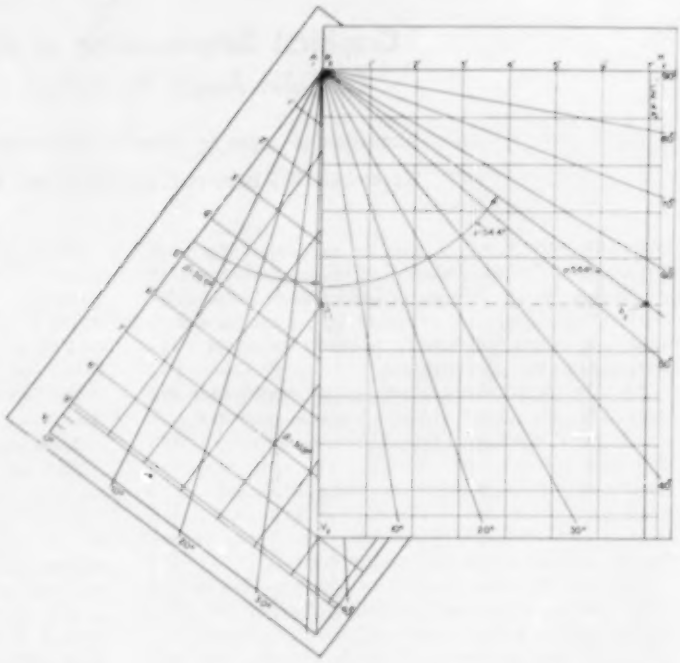


Figure 3, Wiseman. (right) Overlay of Sheet 2 on Sheet 1 — angle α is found on Sheet 2 by locating A_2 at the intersection of the "line of A" and the perpendicular to P_2V_2 from A_1.

Figure 4, Wiseman (below) Orthographic polar projection of A.

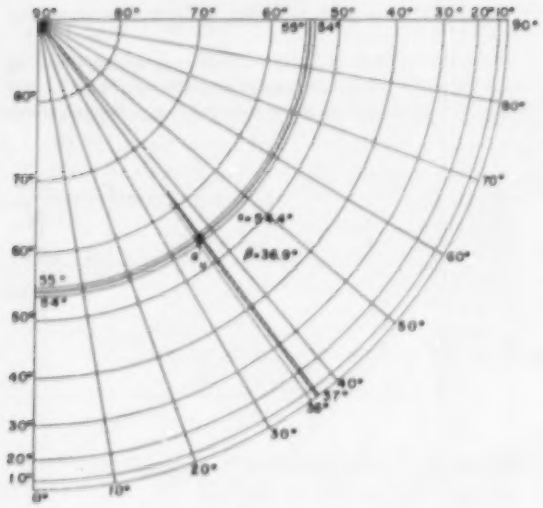


TABLE I — Accuracies of calculations by using the solid angle projection method with graphical determination of angles. Sources were perfectly diffusing with uniform brightness.

Source	Orientation	Per Cent Error
Rectangular	Fig. 6 and 7	+0.13
Rectangular	P off set	+0.22
Strips	Fig. 9 — A	+2.9
	B	+4.4
	C	+10.4
	AVG	+3.9
Circular	Parallel — P located on	
	(1) Normal to center	−1.2
	(2) Off-set	0.0
Circular	Perpendicular to plane of P	+2.7
Elliptical	Parallel — P located on normal to center	−0.36
Triangula	Oblique to plane of P	+0.21

sphere with radius of 7.071 inches. The accuracies for these solutions may be increased by using a larger radius sphere.

This solid angle projection method was also used to calculate the illumination from an elliptical source when P was not on the normal to the center of the ellipse and for a source with irregular boundary. In order to check these solutions, the elliptical and irregularly shaped sources would have to be divided into smaller sources with simple boundaries, illumination for each component calculated and the results totalled.

This solid angle projection method which Professor Krachenbuchl has presented, enables one to solve convential problems much more rapidly than is possible by evaluating equations, and it also has the great advantage in that it can be used for calculating the direct illumination from any perfectly diffusing source regardless of shape or orientation.

R. D. BURNHAM:* Professor Krachenbuchl is to be complimented on the ability to simplify a complex design procedure to a simple graphical form, such as described in this paper.

The illuminating engineer interested in investigating or designing lighting systems in exact nature will find tools such as these very helpful. The means of analysis described provide a method of analyzing lighting problems heretofore too complex to handle mathematically. This method of making calculations by means of the "unit sphere method" allows the point by point calculation for surface sources.

A room with any particular brightness distribution can be analyzed to determine the illumination distribution on various planes at any particular point. From this, modeling shadows within the occupied zone of the room could be calculated.

*The Wakefield Company, Vermilion, Ohio.

INSTALLATION AT WAYNE HUMMER AND COMPANY
105 WEST ADAMS STREET, CHICAGO, ILL.

Lighting an Office

LIGHTING OBJECTIVE: To provide well distributed general illumination with good brightness distribution and reduced glossy work reflections in an office where intensive work is done on business machines and large sheets of columnar calendared paper.

GENERAL INFORMATION: This 6500 square foot area covers the general, sales and executive offices of a member of the New York Stock Exchange. The ceiling height is 9 feet 8 inches except under the air conditioning duct where it drops to 7 feet 3 inches. Surface characteristics are as follows:

ceiling, acoustical tile	near white	80% RF
walls	warm light gray	35% RF
floor		
clerical area, tile	mottled green	7% RF
sales and executive offices, carpet	taupe	13% RF
desk tops	gray	12% RF
counter tops	gray	12% RF

Note: While the lighting is satisfactory the reflection factors for the floor and the dark desk and counter tops do not meet the recommendations of the I.E.S. Recommended Practice of Office Lighting.

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A.I.A. File No. 31

Figure 2. View of general office area.

INSTALLATION: All of the luminaires are manufactured by the Solar Light Manufacturing Company, Chicago, Illinois. One hundred and seven ceiling mounted luminaires (catalog No. CL-1260) and twelve recessed luminaires (catalog No. RL-1260) are mounted largely in rows, broken by beams, all in the same direction. The average spacing between rows is 6 feet and the recessed luminaires are located in the dropped ceiling at the air conditioning ducts. Air delivered to the rooms from these ducts is admitted below the lamps to avoid any adverse effects due to the draft (see Fig. 2). All of the ceiling mounted and recessed luminaires are equipped with louver assemblies which provide 40-degree crosswise and 35-degree lengthwise shielding. The louver assemblies are easily removed for cleaning and lamp replacement. Two special luminaires are mounted at angles for the quotation board. All luminaires use two 40-watt T-17 instant start standard cool white fluorescent lamps.

Average illumination after two months' use, about 600 burning hours, on the desks and counters was 73 footcandles with a maximum of 85 footcandles and a minimum of 47 footcandles. Brightnesses were as follows:

louvers	
at 30°	275 ft-L
at 45°	500 ft-L
ceiling	
average	10 ft-L
maximum near luminaires	22 ft-L
wall	
average	10 ft-L
maximum	30 ft-L
minimum	5 ft-L

Lighting designed by John W. Peterson, currently Branch Manager, Graybar Electric Company, Inc., 1140 North Irwin Avenue, Green Bay, Wisconsin; illuminating engineering consultant: Leonard V. James, 513 South Catherine Avenue, La Grange, Illinois.

Lighting data submitted by Leonard V. James, La Grange, Illinois and the Solar Light Manufacturing Company, 400 North Ashland Avenue, Chicago, Illinois, as an illustration of good lighting practice and to aid in the design of similar installations.

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Series XX 12-55

Effect of Street Lighting on The Night Traffic Accident Rate

By F. D. WYATT
E. LOZANO

In many large cities throughout the country, studies have been made to determine what effect the illumination of a roadway has upon the nighttime accident rate. The task is quite difficult under normal circumstances because of the presence of other variable factors which also influence the nighttime accident rate. However, by careful analysis of traffic accident records, it is possible to show that accident rates at night are decreased as a result of improved lighting conditions or, in other words, higher levels of illumination.

By examination of traffic accident reports received from the Traffic Section of the Chicago Park District, it is possible to show graphically the value and importance of higher levels of street lighting in reducing the nighttime accident rate. Examination of Fig. 1 shows that on Michigan Boulevard between 12th Street and 16th Street where the average lighting level is 0.350 footcandles the nighttime accident rate per million miles of travel for fatal and non-fatal accidents is 6.43. Michigan Boulevard between 16th and 22nd Streets has an average lighting level of 0.88 footcandles and an accident rate of 2.3. On Lake Shore Drive with an average level of 1.3 footcandles, the night accident rate is 1.09. Therefore, we do observe a definite tendency to reduce the nighttime accident rate by increasing the average lighting level. We have selected two boulevards which fall in the same general classification in relation to vehicle miles traveled; that is, boulevards having more than 10 million vehicle miles of travel per year. The type of lighting installation which exists on each of the boulevards mentioned is listed below:

Michigan, 12th-16th—10,000-lumen incandescent lamp.

Michigan, 16th-22nd — 400-watt E-H1 mercury vapor lamp.

Lake Shore Drive — 400-watt E-H1 mercury vapor lamp.

The diagram shown on Fig. 2 indicates the *fatal and non-fatal* night accidents that were saved as a result of improved lighting. Accident data were obtained for a particular section of Michigan Boulevard and a comparison was made of accidents which occurred before relighting (1947) and after relighting (1949). The daytime accident rate for 1949 was approximately 100 per cent greater than that for 1947, as a result of the increase in traffic volume. The main factors which would cause a variation of the nighttime accident rate are traffic volume and level of illumination.

A 19-year record for all Boulevards and Drives of the Chicago Park District shows that the increase in traffic volume at night results in an increase of the night accident rate in the same proportion as the day rate.

Prediction of future accidents based on this correlation shows that the nighttime accident rate for 1949, without improved lighting, would have been approximately 13.3. Traffic records reveal that the night rate for 1949 was actually 2.49. Therefore, as a result of improved lighting, an 81 per cent saving in fatal and non-fatal accidents was realized.

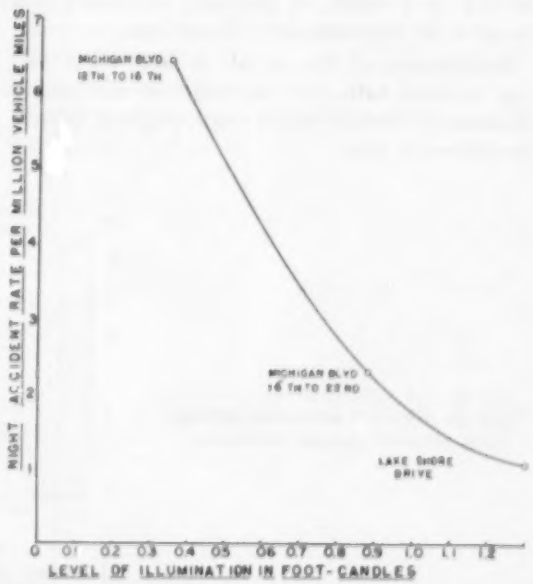

NIGHT ACCIDENT RATE PER MILLION VEHICLE MILES
MICHIGAN BLVD 12TH TO 16TH
MICHIGAN BLVD 16TH TO 22ND
LAKE SHORE DRIVE
0 01 02 03 04 05 06 07 08 09 10 11 12
LEVEL OF ILLUMINATION IN FOOT-CANDLES

Figure 1. Trend in nighttime fatal and non-fatal accident rate under various levels of illumination for 1951.

A paper presented at the National Technical Conference of the Illuminating Engineering Society, September 12-16, 1955, Cleveland, Ohio. Authors: Chicago Park District, Chicago, Ill.

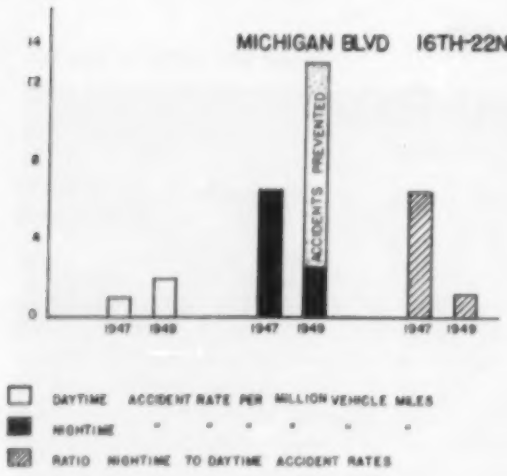


Figure 2. Effect of improved lighting upon fatal and non-fatal accidents.

The diagram designated as Fig. 3 illustrates the savings in nighttime *property damage* accidents which may be accredited to improved lighting. We shall apply the same prediction made for Fig. 2, that is, that without improved lighting the night accident rate for property damage accidents in 1949 would have been increased by the same proportion of increase that occurred in daytime property damage accidents. While the graph shows an increase in night accidents for 1949, we see that the increase is, nevertheless considerably lower than the expectancy. By the prediction made, the expectancy would be 17.0 property damage accidents per million vehicle miles. The actual rate from traffic records was 6.96. Therefore, the per cent savings as a result of increased illumination is found to be approximately 61 per cent.

Examination of the overall or *total night and day* accident rates for two adjacent sections of Michigan Boulevard which were relighted, reveals the following data:

Section		Accident Rates Per Million Vehicle Miles Daylight	Dark
12th to 16th Street	1947	3.6	9.8
	1949	9.4	7.3
16th to 22nd Street	1947	4.84	12.74
	1949	12.80	9.45

The expectancy of nighttime accidents for 1949, applying the same prediction made previously, would be:

12th to 16th Street:

Ratio of daylight increase (1949 to 1947) ..... $\frac{9.4}{3.6} = 2.6$

Expectancy of nighttime accidents, 1949 is ..... $9.8 \times 2.6 = 25.5$

Actual rate for 1949 was 7.3

Per cent saving as a result of improved lighting was ..... $\frac{25.5 - 7.3}{25.5} = 71.5\%$

16th to 22nd Street:

Ratio of daylight increase (1949 to 1947) ..... $\frac{12.80}{4.84} = 2.64$

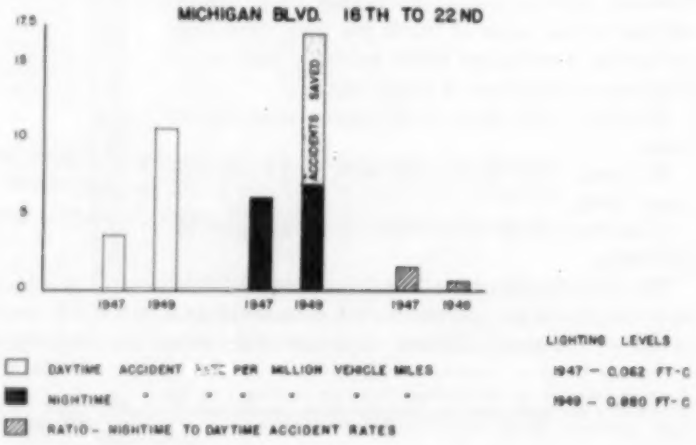

MICHIGAN BLVD. 16TH TO 22ND
ACCIDENTS SAVED
1947 1949 1947 1949 1947 1949
DAYTIME ACCIDENT RATE PER MILLION VEHICLE MILES
NIGHTIME
RATIO - NIGHTIME TO DAYTIME ACCIDENT RATES
LIGHTING LEVELS
1947 - 0.062 FT-C
1949 - 0.880 FT-C

Figure 3. Effect of improved lighting upon property damage accidents.

Expectancy of nighttime accidents, 1949 is	$12.74 \times 2.64 = 33.6$
Actual rate for 1949 was	9.45
Per cent saving as a result of improved lighting was	$\frac{33.6 - 9.45}{33.6} = 71.7\%$

A visual picture of the above results can be obtained by a study of Fig. 4.

Cost of Relighting Chicago Park District Boulevards Compared to Savings Resulting From a Reduction in Nighttime Accident Rate

Costs set up by the National Safety Council released July 1954:

Each death	$22,600
Each non-fatal injury	1,250
Each property damage accident	190

Accident data obtained from Traffic Section of the Chicago Park District for the year 1949 for all Boulevards.

Fatal	40
Non-fatal	1290
Property damage	4365

The cost of relighting the Chicago Park District Boulevards is indicated by a recently completed typical installation on which the costs were as follows:

Cost of Modernizing Lighting to Conform To I.E.S. Standards (American Standard Practice for Street and Highway Lighting)

PER LAMPPOST

	Material	Labor	Total
Lamppost complete, including luminaire, lamp and ballast	$260	$110	$370
Lamppost foundation	22	80	102
TOTAL — per lamppost	$282	$190	$472

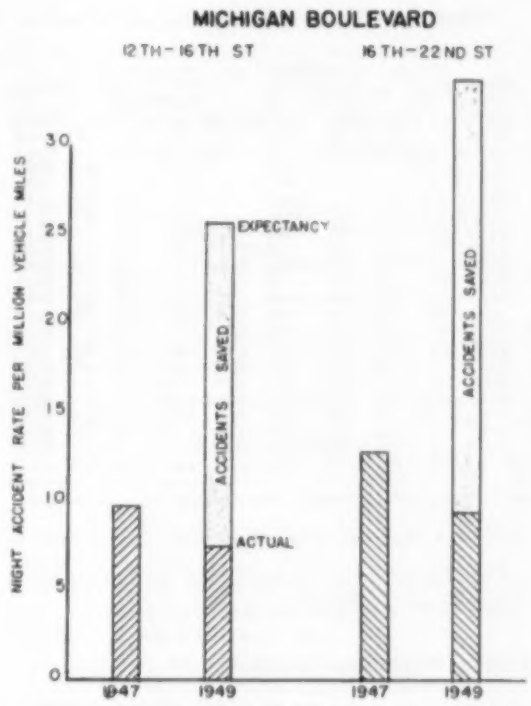


Figure 4. Effect of improved lighting upon total nighttime accidents.

PER MILE

	Material	Labor	Total
Lampposts complete, including luminaire, lamp and ballast	$13,520	$5,720	$19,240
Lamppost foundations	1,144	4,160	5,304
TOTAL — Lampposts, per mile	$14,664	$9,880	$24,544
On older Boulevards considerable rebuilding of underground system was necessary			$18,156
New cable and rearrangement of existing cables	3,228	4,956	8,154
TOTAL, PER MILE			$50,884

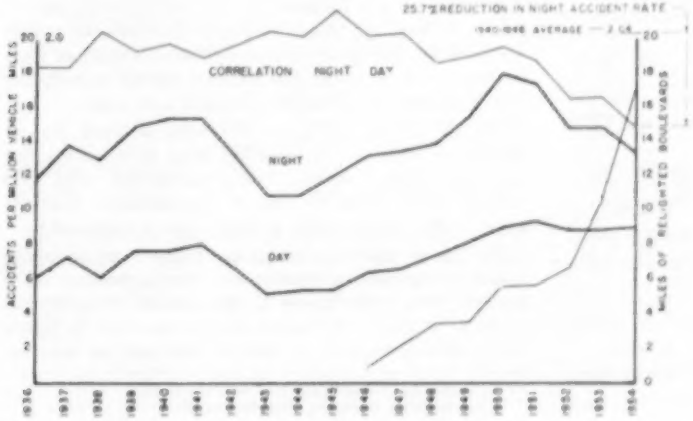


Figure 5. Accident rates for all Chicago Park District Boulevards and Drives.

TABLE I.—Chicago Park District, all Boulevards and Drives, Accident Rates and Vehicle Miles Traveled.

	DAYLIGHT									DARK									RATIO OF DAYLIGHT TO DARK			
	Millions of Vehicle	Accidents				Accidents Per Million Veh. Miles				Millions of Vehicle	Accidents				Accidents Per Million Veh. Miles							
Year	Miles	F	NF	PD	T	F	NF	PD	T	Miles	F	NF	PD	T	F	NF	PD	T	F	NF	PD	T
1936	643				4098				6.37	289				3382				11.70				1.84
1937	702				5283				7.53	316				4388				13.89				1.84
1938	704				4449				6.32	317				4122				13.00				2.06
1939	718				5541				7.72	323				4840				14.98				1.94
1940	764.2	26	1493	4480	5991	0.04	1.94	5.86	7.84	343.4	62	1757	3520	5339	0.18	5.12	10.25	15.55	4.50	2.64	1.75	1.98
1941	814.4	27	1586	4996	6611	0.03	1.95	6.14	8.12	365.9	69	1839	3728	5636	0.19	5.02	10.19	15.40	6.33	2.57	1.66	1.90
1942	656.6	14	1175	3242	4431	0.02	1.79	4.94	6.75	295.0	47	1295	2600	3943	0.16	4.39	8.81	13.36	8.00	2.45	1.78	1.98
1943	516.8	17	821	1883	2721	0.03	1.59	3.64	5.26	232.2	44	906	1569	2519	0.19	3.90	6.76	10.85	6.33	2.45	1.86	2.06
1944	518.7	17	814	1982	2813	0.03	1.57	3.82	5.42	233.0	47	969	1537	2553	0.20	4.16	6.60	10.96	6.67	2.65	1.73	2.02
1945	562.6	24	958	2142	3124	0.04	1.70	3.80	5.54	253.3	46	1095	1913	3054	0.18	4.32	7.55	12.05	4.50	2.54	1.99	2.18
1946	737.7	13	1344	3524	4780	0.02	1.71	4.84	6.57	326.9	66	1426	2863	4355	0.20	4.36	8.76	13.32	10.00	2.55	1.81	2.03
1947	803.2	26	1325	3962	5313	0.03	1.65	4.93	6.61	360.8	42	1581	2239	4862	0.12	4.38	8.98	13.48	4.00	2.65	1.82	2.04
1948	843.3	11	1374	4909	6294	0.02	1.63	5.82	7.47	378.9	47	1400	3818	5265	0.13	3.69	10.08	13.90	6.50	2.26	1.73	1.86
1949	893.6	15	1347	5852	7214	0.02	1.50	6.55	8.07	401.5	46	1378	4719	6143	0.12	3.43	11.75	15.30	6.00	2.29	1.79	1.90
1950	953.2	11	1486	7261	8758	0.01	1.56	7.62	9.19	428.2	44	1610	6118	7772	0.10	3.76	14.29	18.15	10.00	2.41	1.88	1.97
1951	971.0	19	1488	7528	9035	0.02	1.53	7.75	9.30	436.3	38	1511	6090	7639	0.09	3.46	13.96	12.51	4.50	2.26	1.80	1.88
1952	976.7	23	1592	7155	8770	0.02	1.63	7.75	8.98	438.8	39	1409	5091	6539	0.09	3.21	11.60	14.90	4.50	1.97	1.58	1.66
1953	996.7	11	1702	7230	8944	0.01	1.71	7.25	8.97	447.8	35	1462	5224	6721	0.08	3.26	11.67	15.01	8.00	1.91	1.61	1.67
1954	1024.4	22	1862	7419	9303	0.02	1.13	7.24	9.08	460.3	38	1469	4705	6212	0.08	3.19	10.23	13.49	4.00	1.75	1.41	1.49

Code: F—Fatal; NF—Non-Fatal; PD—Property Damage; T—Total.

For the following calculations we have used a round figure of $50,000 per mile.

Cost of Nighttime Accidents

Fatal	40 @	$22,600 =	$ 904,000
Non-Fatal	1290 @	1,250 =	1,612,500
Property Damage	4365 @	190 =	829,350
		Total cost —	$3,345,850

Assuming, from results obtained in previous calculations, that approximately 70 per cent of the nighttime accidents could be eliminated by improved lighting, we obtain:

Possible annual saving—70 per cent of $3,345,850 = $2,342,095.

Cost of Relighting 205 Miles Of Park District Boulevards

Average cost of $50,000 per mile multiplied by 205 miles — $10,250,000.

$$\text{Span of Program} = \frac{\$10{,}250{,}000}{\$2{,}342{,}095} = 4.38$$

Therefore, we see that in a period of less than five years, the complete cost of relighting all Boulevards would be balanced by the savings in nighttime accidents.

The elimination of this menace to night driving and the essential planning of an extensive program of street relighting is a responsibility resting upon every citizen and all who are working in the best interests of the General Public.

Table I shows the day and night time accident rate per million vehicle miles for the interim of 1936 to 1954, inclusive. It should be noted that there was a marked decrease in both the day and night accident rate during the war years, 1942 to 1945 inclusive, when highway speeds were limited to 35 miles per hour. It should also be noted that there has been a gradual reduction in the night time accident rates since 1950, at which time the effect of improved street lighting on the Park District Boulevards began to show results. As the lighting on more Park Boulevards is improved, it is anticipated that there will be a continuing reduction in the night accident rate.

DISCUSSION

JOHN E. DAWSON:* Are any of the data which the authors have taken based on the relationship between good street illumination and regulated speeds on highways, such as from 25 to 55 miles per hour, which is allowed on freeways and expressways?

HAROLD E. MASON:** Mr. Wyatt and Mr. Lozano have given us a simple, straightforward demonstration that new street lighting installation costs are economically justified by reduced accident costs. The methods that they have used can be easily followed by each of us in our situation. Their cost figures for new lighting per unit and per mile; and for fatal, non-fatal and property damage accidents, all appear to me to be very good. I assume that the accident costs are those now in use by the National Safety Council, and that these costs are gradually increased each year.

I would like to ask if the 205 miles of Park District Boulevards have been in existence since 1936, or has this boulevard system increased during this period? Also, have some of these boulevards been at the saturation point for many years so far as traffic in peak hours is concerned?

The use of reduced accident and crime costs to justify new street lighting construction is always interesting, and I am glad to get new figures on the subject. However, this might be said to be the fear or negative approach to justify street lighting budgets. It may be that such an approach

*Public Lighting Commission, City of Detroit, Mich.
**Street Lighting Engineer, Philadelphia, Pa.

is sometimes necessary, particularly with some bankers or other financial men.

In Philadelphia, some eight years ago, we made a clean break from old street lighting, and lighted a new boulevard with the best of modern mercury vapor lighting. We did not try to make a gradual change but were very careful to be sure that our spacings, locations, mounting heights, and bracket lengths complied with the Code. Similar steps were also taken on medium traffic and on residential streets.

Since then the City and the public have realized that modern lighting adds to the beauty, comfort and convenience of our streets, and we have not lacked for money for new lighting projects. The amount of lighting we have been able to put in, however, has been limited by other factors.

This positive approach to the raising of street lighting budgets has, I am sure, been equally effective in Chicago and elsewhere as in Philadelphia. Up to date we have not had to use accident and crime statistics to obtain these budgets.

DAVID M. BALDWIN:* This paper presents very valuable data on the night accident experience of a heavily traveled street in Chicago. It is of special interest because traffic volume figures are available and accident rates on a day and night vehicle-mile basis are calculated and presented by the authors.

It would have been helpful if actual accident figures had also been presented for the relatively short section of street studied. It might be argued that the sample was too small for the changes to be significant, but this cannot be checked because the data are not reported.

One minor criticism is offered to the comparison of accident rates for Michigan Boulevard from 12th to 22nd Streets and Lake Shore Drive, made in Fig. 1. The two streets are so dissimilar in physical and traffic characteristics as to make such a comparison rather meaningless.

The paper represents a real contribution to the knowledge of this subject and the authors are to be congratulated on making available so much valuable data on actual accident rates.

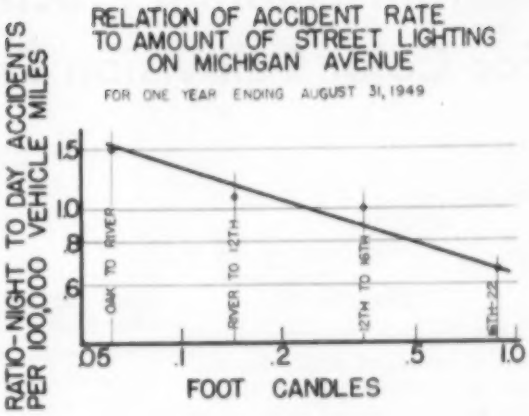
F. D. WYATT and E. LOZANO:** We wish to thank the several discussors for their comments on this paper.

In reply to Mr. Dawson, we would state that the Park District Boulevards have posted speeds of 25 mph to 45 mph. This maximum speed is on divided highways.

Actual measured speeds by elapsed time for several boulevards are as follows:

	Legal Speed	Morning Rush Hour	Evening Rush Hour	Light Load
Michigan Boulevard	25	14.8	13.6	30
Lake Shore Drive	45	24.8	25.4	45

No attempt has been made to correlate the effect of speed on the accident rate. However, we have observed that traffic is expedited and speeded up when the light level is increased on the street.



In reply to Mr. Mason, we would state that there has been no appreciable change in mileage in Park District Boulevards between 1936 and 1954.

Mr. Baldwin's comments regarding differences in Michigan Boulevard and Lake Shore Drive are well taken. However, we do find that not much difference exists in the accident rates in Michigan Boulevard (25 mph) and Lake Shore Drive (45 mph) due to the difference in the legal speed limits. However, we have other studies taken entirely on Michigan Boulevard which the attached diagram depicts. Light levels varied in different sections from 0.06 footcandle up to 0.88 footcandle. The pedestrian exposure on the section from 12th to 16th Streets was unusually high due to all night traffic at a hospital entrance and due also to heavy left-turn automobile traffic at two intersections. Note that with the higher level of illumination the ratio of night to day accident rates was 66 per cent, compared with 150 per cent for the low level of illumination.

It should be emphasized that by the end of 1954 — a total net reduction in the night accident rate of 25.7 per cent had already been achieved below the 1940-1946 average due to the improved lighting on boulevards installed up to that time.

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*Director, Traffic Operations Division, National Safety Council, Chicago, Ill.

**Authors.

Current Lighting Practices For Color Television Production

Prepared by the Committee on Lighting for Television Production of the Illuminating Engineering Society

PREFACE

At the present time, the general trend in lighting of studios for color television production is essentially the same as that described in the Committee's reports "Current Lighting Practice for Television Production," December 1950 and "Progress in Television Studio Lighting," April 1954, for production of black and white pictures. There are, however, some modifications and limitations in color television lighting practice which are given in the various sections of this report. Since the development of live color programs has essentially emanated from two major networks, the information on lighting for color television production is largely from their experiences.

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1. Color Television Cameras

1.1—*Pick up and Transmission*—(a) The process of pick up and transmission for color television is somewhat more complicated than the method for monochrome (black and white) pictures. At this writing there are two camera types in use.

(b) Fig. 1 shows the schematic diagram of the tri-tube system in which the red, blue, and green, components of the image received through the camera lens are separated by dichroic mirrors (light beam splitter) and reflected individually to each one of three Image Orthicons. Neutral density (colorless) filters and color filters are inserted in the optical path to help produce a spectrum balance.

(c) Fig. 2 shows the schematic diagram of the sequential system in which the red, blue and green components of the image received through the camera lens are intercepted by a synchronous rotating colorwheel, having alternate segment color filters of the three primary colors, which pass on to a single Image Orthicon. These sequential signals are subsequently converted in the Chromacoder into red, green and blue signals.

(d) From this point on, both systems are identical under the present U. S. Standard Color Television System (established by the former National Television System Committee) in going to a matrixing* device. Samples of the primary color signals are carried electrically to a matrixing unit which combines them to make the brightness or black and white signal. At the same time, samples of the three primary colors are fed to a "mixer" which combines them to produce a signal carrying the hue and saturation information. This color information signal is then combined with the brightness signal to form the complete color television isgnal for transmission.

1.2—*Compatible Broadcast Signals* — When the compatible color television broadcast signals reach a standard black and white receiver, the color signal is ignored by the receiver's circuit while the brightness or black and white signal is passed on and produces a high definition black and white picture. However, when the color television broadcast signals are picked up by a standard antenna connected to a color television receiver, the two signals are processed through the circuit and projected on to the tri-color Kinescope as a full color picture. Likewise, if a black and white signal broadcast by a black and white camera pick up is received on a color television receiver, the results will be a black and white picture.

2. Light Sources

2.1—*General*—Response characteristics of color cameras are critical and experience has shown that the spectral characteristics of the light sources within a scene should be essentially uniform. Where filament lamps are used, they should remain within a 200-degree Kelvin range limitation. While a camera chain and system can be adjusted to operate with almost any continuous spectrum light source by adjusting the gains of the red, blue, and green channels, a wide variation in the spectral characteristics of the light sources within the picture area will cause unpredictable changes in color reproduction.

2.2—*Incandescent Filament Lamps*—(a) Incandescent filament lamps have been favored for color studio lighting due to their continuous spectrum, their relatively low cost and long life, and the fact that they are available in a wide range of sizes with approximately the same Kelvin temperature. Filament light source color temperatures of 2900 to 3200 K are currently used. Filament lamps are favored for their flexible light control, because their housing equipment is less bulky and of lighter weight, and because existing equipment can be used. Furthermore, they permit the ready use of color filters at the light source.

(b) A camera initially balanced for incandescent filament lighting may be used to take scenes outdoors in daylight with the color temperature varia-

Approved by the Council of the Illuminating Engineering Society, June 1955.

*Electronic mixing process to obtain desired signal.

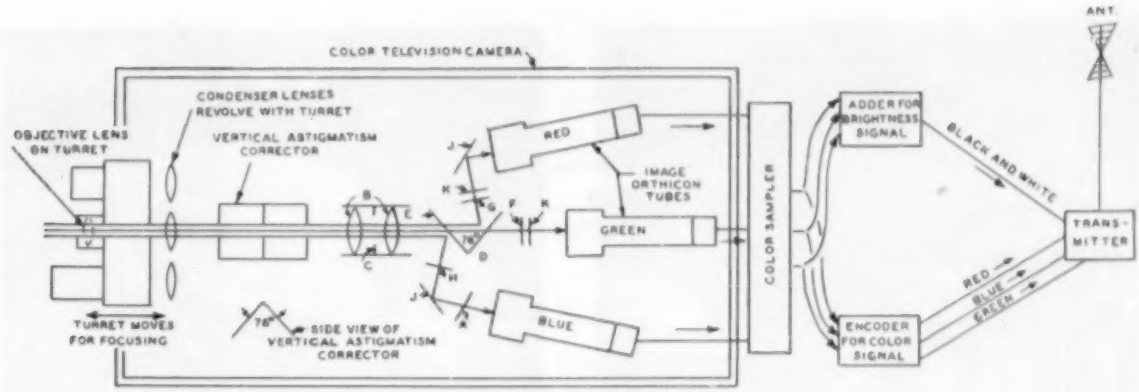

Figure 1. Schematic diagram of tri-tube system.

A — Horizontal Astigmatism Corrector
B — Relay Lenses Both 9.5" F/4
C — Remotely Controlled Iris
D — Red Reflecting Dichroic
E — Blue Reflecting Dichroic
F — Green Trimming Filter
G — Red Trimming Filter
H — Blue Trimming Filter
J — Front Surface Mirrors
K — Neutral Density Filter

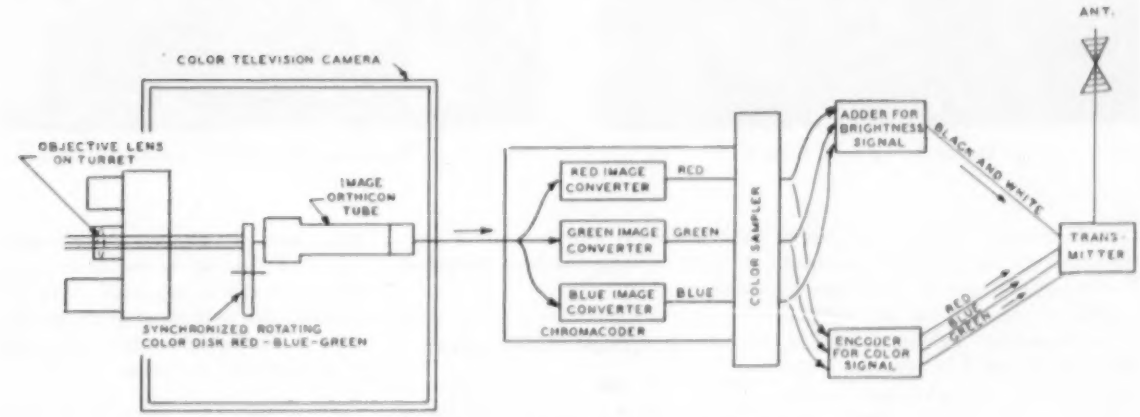

Figure 2. Schematic diagram of sequential system.

tions corrected through the use of suitable filters on the camera lens. Variations in the amount of light are controlled by the camera iris.

2.3—*Mixed Light Sources*— Mixed light sources, such as incandescent and fluorescent, cannot be used to light a scene simultaneously because the camera will not transmit a good color picture where the spectral characteristics of the light sources vary, particularly if they do not have continuous matching spectra.

3. Illumination Levels

For televising color pictures, base lighting levels of 300 to 500 footcandles incident are found satisfactory. Back lighting and key lighting are at a ratio of ½ to 1½ times base light, depending entirely on the subject.

4. Instrumentation

4.1—*Meters*—(a) Although color-corrected, cosine-corrected incident light meters are used for checking purposes, the color television monitor is found to be the best guide when adjusting lights for a given scene.

(b) Kelvin color temperature meters are beginning to be used for matching lights.

4.2—*Contrast Range*— (a) The subject brightness contrast range of black and white is essentially around 20:1 — although it is possible to work satisfactorily in certain conditions to a 40:1 range. In color television studios the subject brightness range seldom, if ever, exceeds the 20:1 range which normally assures a good black and white picture.

(b) Incident illumination that produces a suitable contrast range normally does not exceed 2½ to 1.

5. Lighting Equipment

5.1—*General*— The same type of lighting equipment and controls now used for black and white production are employed in color television studios, but to provide the higher illumination levels required, a greater number of higher wattage units are used to light scenes designed for color televising. To provide general illumination or base lighting on a given scene, 1500-

Figure 3. Tri-tube camera.

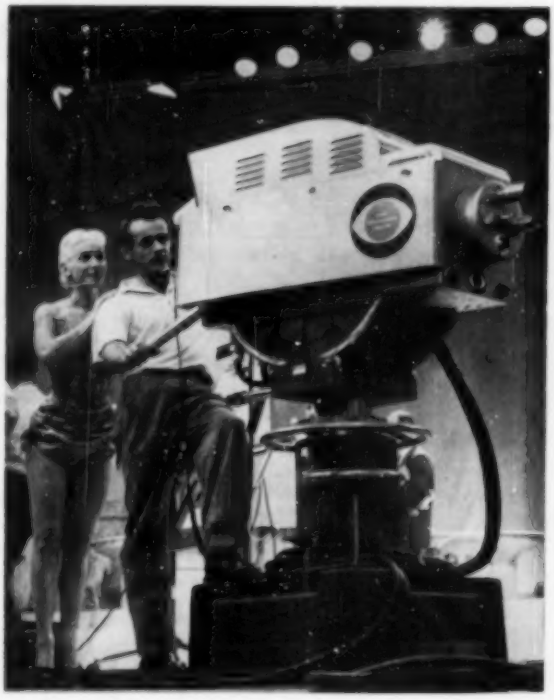

Figure 4. Sequential camera.

watt flood scoops and/or 2 kilowatt to 5 kilowatt Fresnel spotlights are used. The same wattages in beam control equipment are used for key lighting, fill light, and back lighting. Highlighting is done with 2 kilowatt to 5 kilowatt Fresnel spotlights and 3 kilowatt ellipsoidal projector units, while 1000 to 3000-watt ellipsoidal projectors with patterns are used for backgrounds.

5.2—*Cyclorama* Lighting*—Cycloramas are lighted with striplights using either reflectors with 300-watt general service (1000 hour life) lamps or without reflectors and either 300- or 500-watt reflector type lamps. In addition, 500-watt to 2000-watt ellipsoidal spotlights and 1500-watt scoop floods are often used.

5.3—*Color*—Colored lighting for special effects is obtained through the use of colored filters. Striplights as well as other equipment with suitable color filters are used in providing color lighting. Due to the wide variety of colors available, gelatins and plastics are generally used instead of glass. Colored lighting has been extensively used on cycloramas.

*A scenic background or masking surrounding the general area of a television setting, constructed from fabric or other materials, and variously lighted to form an integral part of the scenic design.

6. Projected Backgrounds

While rear projection of scenery is very desirable, it is at present difficult due to the lack of adequate screen brightness. However, backscreen projection is used for silhouette effects.

7. Electrical Installation

7.1—*Electrical Outlets*—(a) Individual control of each studio electrical outlet is general practice. Due to the increase in lighting requirements for color television, the overhead outlets (approximately 90 per cent of studio lighting is done from overhead hanging lighting units) are spaced much closer than in a black and white studio.

(b) A lighting load of between 75 to 100 watts per square foot of studio area is provided with one electrical outlet per 8 square feet. This spacing resolves into one outlet every two feet on pipe battens spaced 4 feet apart. Approximately every third outlet has a 50-ampere capacity while the remaining outlets are wired for 20 amperes each. To produce the necessary increased lighting, it has been found more desirable to use units of higher wattage than to triple or quadruple the present number of smaller units used in monochrome television.

7.2—*Dimmers*—Dimmers are found to be operationally desirable in color television applications. Within-scene changes are satisfactorily produced by lighting controlled through the use of dimmers. They are used occasionally to make color corrections between individual tungsten lamps, but primarily as a switching device for between scene changes, and for balancing the various components of lighting, always within a 200 Kelvin tolerance. A 200-degree drop in Kelvin temperature is roughly a 25-volt drop in voltage and a 45 per cent reduction in light level. Remote control type dimmers (thyratron, electromagnetic, and electromechanical) have been found useful in multiscene variety shows because of their ease in operation and the fact that all their controls are in compact flexible console units. Where the number of dimmers is relatively few, the manual transformer dimmer-type switchboard is equally satisfactory. The present method of remote control

has been found more desirable — permitting greater flexibility, quicker between-scene changes, and a more accurate return to previous light settings.

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8. "Progress in Television Studio Lighting," a report of the I.E.S. Committee on Television Production Lighting, ILLUMINATING ENGINEERING, Vol. XLIX, No. 6, p. 313 (June 1954), also available in booklet form from the Illuminating Engineering Society.

APPENDIX — TELEVISION STUDIO LIGHTING NOMENCLATURE*

1. High Key Lighting — A type of lighting which, applied to a scene, results in a picture having graduations falling primarily between gray and white; dark grays and blacks are present but in very limited areas.

2. Low Key Lighting — A type of lighting which, applied to a scene, results in a picture having graduations from middle gray to black with comparatively limited areas of light grays and whites.

3. Key Light — The apparent principal source of directional illumination falling upon a subject or area.

4. Base Light—Uniform, diffuse illumination, approaching a shadowless condition, sufficient for a television picture of technical acceptability, and which may be supplemented by other lighting.

5. Fill Light — Supplementary illumination to reduce shadows or contrast range.

6. Cross Light — Equal illumination in front of the subject from two directions at substantially equal and opposite angles with the optical axis of the camera and a horizontal plane.

7. Back Light — Illumination from behind the subject in a direction substantially parallel to a vertical plane through the optical axis of the camera.

8. Side Back Light — Illumination from behind the subject in a direction not parallel to a vertical plane through the optical axis of the camera.

9. Eye Light — Illumination on a person to produce a specular reflection from the eyes (and teeth) without adding a significant increase in light to the subject.

10. Set Light — Separate illumination of background or set other than that provided for principal subjects or areas which may be composed of items 3 to 8 above.

Journal of the Society of Motion Picture and Television Engineers, Vol. 64, No. 2, p. 87 (February 1955).

Quality and Economical Aspects of Parking Area Lighting

(Discussion of paper by J. R. Bale, published in November 1955 issue of ILLUMINATING ENGINEERING)

W. H. EDMAN:* As Chairman of the I.E.S. Subcommittee on Outdoor Parking Area Lighting of the Street and Highway Lighting Committee, I should like to comment on Table II of this paper. It appears important to clarify two points which might otherwise be misconstrued. The caption of Table II, "Recommended Average Horizontal Footcandles," could be misinterpreted as having been compiled and adopted by an authorized I.E.S. Committee. To date, no I.E.S. recommended practice for the lighting of parking areas has been issued.

The second point pertains to the footcandle values contained in Table II. These do not necessarily reflect any committee thinking. The author has presented only his ideas of footcandle levels for the different classifications of parking areas. Based on studies up to the present time, our committee thinking on these points differs somewhat, having fewer and different classifications and having the minimum recommended illumination requirements follow more closely that of our present "American Standard Practice for Street and Highway Lighting." Since there are several other I.E.S. Committees directly concerned with the lighting of parking areas, it is not possible to present a specific recommendation until such time as these committees have formally voted approval and, in turn, obtained the approval of the I.E.S. Council for publication.

These remarks are not intended in any way to be critical of the author's excellent paper on an important and most timely subject.

J. R. BALE:* I sincerely appreciate Mr. Edman's comment bringing to my attention a possible misunderstanding that might occur concerning Table II. It was not my intention that the values in this table be in any way interpreted as values recommended by an I.E.S. committee or any other individual or body aside from the author. I regret that a subscript to this effect was not added to the paper.

*The Holophane Co., Inc., Newark, Ohio.

*Author, Westinghouse Electric Corp., Cleveland, Ohio.

Among the numerous duties specified for the General Secretary in the Constitution is the requirement that he prepare annually a report for publication in the designated official publication, ILLUMINATING ENGINEERING. This report, based on material received from the Officers, Committees, and Sections and Chapters, has been assembled with the assistance of the staff at headquarters. A brief preview of certain phases of this report was presented at the opening session of the National Technical Conference in Cleveland, September 12, 1955.

The General Secretary Reports

By KIRK M. REID

Membership

Statistics — Table I of this report shows the present membership of the Society compared with figures at the conclusion of each of the past five fiscal years. These figures continue to show a growth in the major membership classifications. The growth of the Society's membership since 1906 is shown graphically in the curves of Fig. 1.

Table II of this report records the gains and losses for the year and the general accounting of changes in all grades of membership. The over-all net increase of 276 brings the total membership of the Society to 8178. Table III records the Society membership by Sections and Chapters divided according to grade of membership.

Members Emeritus, Fellows — The Constitution of the Society specifies two grades of membership designed to recognize Members who have made contributions to the activities of the Society and to the general field of illuminating engineering. This year action was taken by Council naming as Members Emeritus three who performed for the Society services of such meritorious character as Council deemed worthy of this honorable reward. They are:

A. I. Benedict, Southern California Section
Paul F. Kauffman, Chicago Section
Norman Macdonald, New York Section

Based on their valuable contributions to the technical activities of the Society and to the science or art of illumination 12 Members of the Society were recommended by the Board of Fellows and were approved by Council. They are:

C. L. Amick	C. A. B. Halvorson
L. E. Barbrow	C. D. Gibson
A. C. Barr	Carter Lewis
B. S. Benson, Jr.	W. A. Pennow
A. H. Clarke	Mary E. Webber
C. L. Cottrell	C. E. Weitz

Deceased—The Society records with sorrow the death of 1 Member Emeritus, 19 Members and 16 Associate Members during the fiscal year.

Member Emeritus

Waterbury, John H.

Members

Ainsworth, George	Kelly, Nicholas J.
Bracken, William W.	Moore, C. H.
Clarkson, Ben	Rimmer, E. F.
Claude, Andre	Russell, Samuel F.
Cooley, George R.	Sawer, Harold A.
Crump, R. J.	Scott Hoyt S.
Gorman, W. D.	Scutt, George W.
Ilgner, Howard F.	Seeberg, W. A.
Keller, Earl H.	Slade, Leslie W.

Stein, Eugene M.

Associate Members

Booth, Thomas C.	Kramer, Louis
Chassaing, Frank X.	Lamberth, Ray
Conrad, Howard E.	Lewin, Hans Salomon
Dunlap, Paul E.	Linville, Melvin A.
Frischherts, Raymond	Misrach, S. G.
Hardie, L. C.	Richardson, Hugh M.
Hawley, William E.	Steele, Walter D.
Johnson, H. E.	Williams, J. B.

TABLE I — Membership as of September 30.

	1950	1951	1952	1953	1954	1955
Members Emeritus	33*	32*	34*	32*	34*	35*
Fellows	40	42	41	70	78	89
Members	1,610	1,709	1,797	1,870	1,939	1,979
Associate Members	5,005	5,174	5,293	5,579	5,621	5,887
Student Members	369	269	229	244	230	188
Total	7,057	7,166	7,394	7,795	7,902	8,178
Fellows of the Society included	*9	*10	*11	*12	*12	*12

TABLE II — Gains and Losses in Membership During Year Ending September 30, 1955.

	Members Emeritus	Fellows	Members	Associate Members	Student Members	Total
October 1, 1954	34	78	1,939	5,621	230	7,902
Gains						
Elections	0	0	80	859	75	1,014
Reinstatements	0	0	30	128	1	159
Transfers	3	12	86	14	0	115
Total Gains	3	12	196	1,001	76	1,288
Losses						
Resignations	0	1	71	351	51	474
Dropped	0	0	49	283	55	387
Deceased	1	0	19	16	0	36
Transfers	1	0	17	85	12	115
Total Losses	2	1	156	735	118	1,012
Net Change	1	11	40	266	−42	276
Total Membership as of September 30, 1955	35*	89	1,979	5,887	188	8,178

*Includes 12 Fellows.

Regional Activities

Committee Program — The program of the ten Regions, and the constituent Sections and Chapters was again guided by the Committee of ten Regional Vice-Presidents headed by Marshall N. Waterman, Vice-President of the Society. Regular committee meetings were held on the day before Council and the resulting actions were carried out through the visits of the Re-

TABLE III.—Membership of Sections and Chapters as of September 30, 1955.

	Members Emeritus	Fellows	Members	Associate Members	Student Members	Total
CANADIAN REGION						
Blue Nose Chapter			7	16		23
Hamilton, Ontario Chapter			4	25		29
Maritime Chapter			4	31		35
Montreal Section			27	80		117
Ottawa Chapter			11	27		38
Quebec Chapter			8	28		36
Toronto Section		3	43	177		223
Winnipeg Chapter			5	44		49
EAST CENTRAL REGION						
Capital Section	1 (1 F)	4	39	51	1	96
Eastern Pennsylvania Section	1		38	112		151
Maryland Section		1	21	53	1	76
Philadelphia Section	1 (1 F)	4	85	202		292
Pittsburgh Section			56	148	3	207
Virginia Chapter	1		20	22	1	44
GREAT LAKES REGION						
Central New York Section	1 (1 F)	3	32	76		112
Cleveland Section	6 (2 F)	27	99	234	5	371
Miami Valley Chapter		1	12	38	2	53
Michigan Section	1	2	63	181	8	255
Northwestern Ohio Section			18	45		63
Ohio Valley Section			26	68	2	96
Rochester Section		1	14	68		83
Western Michigan Section			15	42		57
Western New York Section			11	57		68
INTER-MOUNTAIN REGION						
Arizona Section			17	57		74
New Mexico Chapter			4	25	1	30
Rocky Mountain Section			13	53	1	67
Southern Colorado Chapter		1	8	19		28
Utah Section			18	43		61
MIDWESTERN REGION						
Central Illinois Chapter			9	35	1	45
Chicago Section	6 (3 F)	4	127	379	22	538
Cornhusker Chapter			12	63	1	76
Heart of America Section			31	84		115
Indiana Section		1	26	78	1	106
Iowa Section			20	56		76
Milwaukee Section		1	33	145	2	181
St. Louis Section		1	28	172		201
Twin City Section			23	157	2	182
Twin Ports Chapter			3	27		30
NORTHEASTERN REGION						
Connecticut Section	2 (1 F)	2	33	124	2	163
Eastern New York Section	3 (1 F)	1	17	56		77
New England Section	1	9	78	248	2	338
New York Section	2	12	176	365	8	563
PACIFIC NORTHWEST REGION						
British Columbia Section			25	57		82
Inland Empire Chapter			6	43		49
Oregon Section	1		30	61	11	103
Puget Sound Section			25	83	2	110
Vancouver Island Chapter			4	19		23
SOUTHERN REGION						
Alabama Chapter			21	45	1	67
Arkansas Chapter			6	26		32
Florida Section	2 (1 F)		14	70	3	89
Georgia Section			53	82	3	138
Mid-South Chapter			8	21	38	67
Mississippi Chapter			7	24	3	34
New Orleans Section			19	70		89
Palmetto Chapter			11	38	3	52
Southeast Florida Chapter			8	45	16	69
Suwannee River Chapter			18	38		56
Tar Heel Section		1	29	82	4	116
Tennessee Valley Section			24	52	2	78
SOUTH PACIFIC COAST REGION						
Golden Gate Section	1	2	61	229	4	297
Mother Lode Chapter			12	25		37
San Diego Chapter	1	1	27	37		66
San Jose Chapter		1	9	22	1	33
Southern California Section	2 (1 F)	2	74	237	17	332
SOUTHWESTERN REGION						
Alamo Chapter		2	15	57	2	76
Ark-La-Tex Chapter			11	24	1	36
Central Oklahoma Chapter			6	28		34
Oil Capital Section			16	36	3	55
San Jacinto Section			15	48		63
Southwestern Section		1	31	101	2	135
Foreign Non-Section	2	1	44	148	5	200
Mexico Chapter			4	28	1	33
TOTAL	35 (12 F)	89	1,979	5,887	188	8,178

gional Vice-Presidents with the officers of Sections and Chapters and by extensive correspondence.

Manuals of Guides for Section and Chapter operation were sent to the new Section and Chapter officers early in the summer before the start of the fiscal year. At their regular meetings the Regional Vice-Presidents discussed many matters related to the maintenance and development of the local group programs. The requests for charters received from three petitioning study clubs were reviewed, and after working out boundaries agreeable to all, were recommended for Council approval.

Favorable recommendation was given to the petition of Chapters requesting transfer to Section status. Such action was taken in behalf of the following Chapters: Arizona, Eastern New York, Indiana, Florida, Northwestern Ohio, Oil Capital, Utah, Western Michigan.

The Regional Vice-Presidents assisted in the assembly of the names of locally appointed chairmen to serve in the national programs for membership, publications, public relations and information. They also reviewed all requests for Section and Chapter budget allotments and recommended these to the National Finance Committee.

Under Society procedure each of the Regional Vice-Presidents organized a Regional Nominating Committee, these selecting candidates for proposal before the National Board and in five instances selecting nominees for election to succeed retiring Regional Vice-Presidents. The Regional Vice-Presidents also assisted in the procedure for submitting candidates for consideration by the Board of Fellows.

In addition to helping with the organization and operation of the Regional Conferences, the Regional Vice-Presidents assisted with the planning of time and place for the Regional Conferences to be held in 1956 and 1957. The Guide for Operation of Regional Conferences (including instructions and material to help with good Conference operation) was circulated to all Regional officers working on the 1955 Conferences.

The subject of a national membership directory was studied during the year including a survey of how many of the Sections and Chapters are at present publishing their own directories. This led to Council's approval of the proposal that each Section and

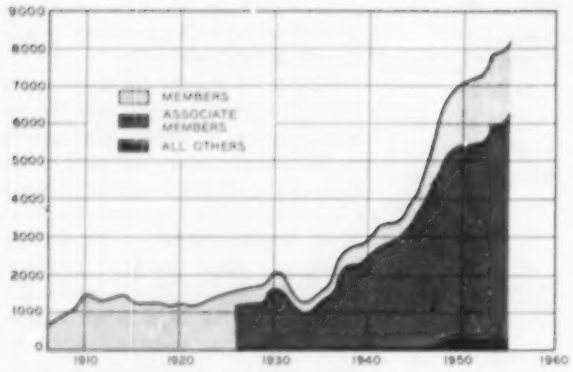


Figure 1. Membership. Total, Members, Associate Members, all others.

Figure 2. Growth of Sections and Chapters.

Chapter supply 100 to 200 extra copies of their own directories in somewhat standardized form for assembly at headquarters, and to be available to national officers, committee chairmen, and members, upon request.

Advance Planning Committee recommendations concerning the financial management and program organization of Regional Conferences, originally proposed in June 1953, were again studied by the Regional Vice-Presidents. The resulting recommendations accepted by Council at the December meeting, continued the financial management of Conferences on a regional basis, without change. The subject of program planning was also studied by the Papers Committee, and following their report to Council, Council approved the proposed cooperation between the national Papers Committee and the Regional Conference Chairman toward the general improvement of Regional Conference programs.

The Committee continued its study of the problem of service by the Regional Vice-Presidents to the Sections and Chapters in the larger Regions. Following Council's earlier agreement in principle as to the division of the Southern Region, subsequent action was taken to postpone such division and to meet the administrative problem by the appointment of an assistant to the Regional Vice-President.

Attention was given to the subject of liability insurance to protect the Society from suits arising out of accidents occurring at local and regional meetings. This resulted in Council action approving the extension of the Society's present liability coverage, beyond the National Technical Conference, to include all meetings of the Sections and Chapters as well as Regional Conferences.

Section and Chapter Programs — The 68 Sections and Chapters of the Society all carried programs of service through local memberships and their committees. According to reports received at headquarters some 554 regular meetings were held during the year, mostly on a monthly basis, with an attendance of members and guests of over 30,000. The scheduling of speakers and subjects for these meetings provide the largest opportunity for direct participation by the membership in the Society program.

A large number of the local groups operated as a regular part of their local program, a study club or technical forum, offering the more detailed discussion of the technical aspects of illuminating engineering.

Residence Lighting Forums continue to be an important activity of six of the Society's Sections, Chicago, Georgia, Michigan, New York and Tennessee Valley with the addition of the Forum at the Utah Section this year. Regular monthly meetings were scheduled by most of the Forums, with discussions and demonstrations conducted by their own members and prominent men and women of the lighting industry and allied fields.

Operating under the revised Guide prepared by the Lighting Service Committee 48 of the Sections and Chapters scheduled "Most Interesting Lighting Job" Contests involving a total of over 250 contestants. Winners in the local contests, which provided unusually fine local programs, went into the Regional Conference competitions.

Student Branches — During the year four of the Society's Student Branches continued active and four were inactive. No new Branches were formed during the year. Regular meetings and programs were operated by the following Student Branches with faculty members as shown serving as Branch Advisors:

Oregon State College
D. W. Shirley, Jr.
Southern College of Optometry
George A. Scott
University of Illinois
Harry W. Horn
University of Miami
Jackson S. Sells

Regional Conferences — Nine Regional Conferences were held. A Regional Conference was not scheduled in the Great Lakes Region because of the planning for the National Technical

New Chapters Established by Council Action During 1954-55.

No.	Chartered by Council Action	Name	Headquarters City	Region	Charter Officers
69	Dec. 9, 1954	Central Oklahoma	Oklahoma City	Southwestern	Elmer R. Pragg, Chairman W. S. Irving, Secretary
70	Mar. 10, 1955	Suwannee River	Valdosta, Ga.	Southern	Wm. H. Sadler, Chairman Maxine R. Music, Secretary
71	July 7, 1955	Bluenose	Halifax, N. S.	Canadian	Henry Lushington, Chairman K. Wilkinson, Secretary

Conference in Cleveland. All Sections and Chapters cooperated in the organization of the Regional Conferences and there was representation at the Conferences from practically every Section and Chapter of the Society. The Conferences continued to maintain high standards of excellence in their programs and in the performance of the respective Conference Executive Committees. The summary of the Conferences and the principal officers in charge follows:

Canadian Regional Conference, May 12-13, 1955, Mount Royal Hotel, Montreal, Robert Tate, Chairman, Canadian General Electric Company, Ltd.

East Central Regional Conference, May 19-20, 1955, Abraham Lincoln Hotel, Reading. Paul Kinsey, Chairman, Metropolitan Edison Company.

Inter-Mountain Regional Conference, April 11-13, 1955, Westward Ho Hotel, Phoenix, J. D. Whitnell Chairman, Arizona Public Service Company.

Midwestern Regional Conference, May 2-3, 1955, Edgewater Beach Hotel, Chicago, Glenn G. Boyd, Chairman, Public Service Division, Commonwealth Edison Company.

Northeastern Regional Conference, June 10-11, 1955, Ft. William Henry Hotel, Lake George, C. E. Waldron, Chairman, Niagara Mohawk Power Company.

Pacific Northwest Regional Conference, April 25-26, 1955, Harrison Hot Springs Hotel, Harrison Lake, B. C., Robert Scott, Chairman, British Columbia Electric Railway Co., Ltd.

Southern Regional Conference, March 31-April 1, 1955, Ft. Harrison Hotel, Clearwater, George N. Jack, Chairman, Raybro Electric Supplies, Inc.

South Pacific Coast Regional Conference, April 14-15, 1955, Statler Hotel, Los Angeles, F. J. Rohring, Chairman, Southern California Edison Company.

Southwestern Regional Conference, April 3-5, 1955, Gunter Hotel, San Antonio, Tom R. Halsey, Chairman, Halsey & Royer.

Local Representatives — With the cooperation of the Regional Vice-Presidents the Sections and Chapters again recommended the appointment of local representatives to carry on the work of the Society in areas not served directly by the local programs of Sections and Chapters. Some of these members have been able to develop especially good programs serving their areas and maintaining interest in the Society.

Finance

Committee Program — The Committee, with W. Warren Booth, Chairman, continued to discharge its constitutional responsibility for direct supervision of the financial affairs of the Society. The Committee's work included as usual, the preparation of the operating budget for the year including allotments to all Sections and Chapters based on a careful review of budget requests as recommended by the Regional Vice-Presidents. The

Statement of Income and Expense for the Year Ending September 30, 1955.

INCOME

Annual Dues		
Fellows	$ 1,147.50	
Members	28,696.38	
Associate Members	74,465.61	
Student Members	821.00	
Entrance Fees	2,520.00	$107,650.49
Sustaining Members		43,391.50
Sales, Publications, Gross		
IES Lighting Handbook, 2nd Edition	7,143.22	
Lighting Data Sheets, Binders	4,340.73	
Reprints	7,484.99	
ILLUMINATING ENGINEERING	11,299.54	
National Technical Conference Preprints (1955)	2,452.96	
Membership Roster	6.00	32,520.44
ILLUMINATING ENGINEERING, Advertising		79,270.87
Sales, Badges and Certificates, Gross		831.75
Investments		3,338.77
1955 National Technical Conference Income	13,875.00	
Less: Expense	12,010.30	1,864.70
Miscellaneous		81.38
TOTAL INCOME		$269,156.90

EXPENSE

General*		$ 10,118.94
Office, Business	$ 47,325.73	
Office, Technical	38,412.37	
Office, Publications	41,428.13	127,166.23
Organization, Committees	2,185.43	
Sections and Chapters	25,995.89	
President's Travel	4,000.00	32,181.32
Sales, Badges and Certificates		530.00
Depreciation, Furniture and Fixtures**		0
Publications Stock***		174.31
ILLUMINATING ENGINEERING to Membership		48,086.87
Sales, Publications, Cost of Stock		
IES Lighting Handbook, 2nd Edition	3,705.60	
Lighting Data Sheets, Binders	1,660.23	
Reprints	4,085.40	
ILLUMINATING ENGINEERING	5,710.28	
National Technical Conference Preprints (1955)	2,220.00	17,381.51
Sales, Publications, Stock, Services, Sales and Advertising Promotion		8,559.07
Retirement Pension Plan		5,995.03
Federal Social Security Tax		1,296.64
To I.E.S. Research Fund		5,000.00
TOTAL EXPENSE		$256,489.92
NET INCOME		$ 12,666.98

*By Council action includes expenditures for furniture and fixtures air conditioning units and installation.

**By Council action total value of furniture and fixtures purchased through September 30, 1955 was reduced to $1.00 and charged off against surplus.

***In addition, value of all stock of I.E. published in 1952, 1953, 1954 and through September 1955 was charged off against surplus, by Council action.

Balance Sheet as of September 30, 1955.

ASSETS

Cash in Banks		$ 73,607.19
Petty Cash Fund		300.00
Accounts Receivable		8,582.28
Investments (Cost)	$ 75,575.01	
Accrued Increments, U. S. Savings Bonds	1,299.00	74,874.01
Inventories, Publications		12,037.67
Furniture and Fixtures		1.00
Deferred Charges to Expense of 1955-56		
Sections and Chapters	3,794.26	
ILLUMINATING ENGINEERING	7,375.76	
General Office Expense*	1,725.00	
Moving Expense	1,001.98	13,807.00
Accrued Interest on Investments		112.50
TOTAL ASSETS		$183,321.65

LIABILITIES AND SURPLUS

Liabilities		
Accounts Payable		$ 7,023.08
Deferred Income		
Dues Received in Advance	$ 2,154.84	
Subscriptions Received in Advance	4,271.85	
Trust Fund, Retirement Pension Plan	852.05	7,278.74
Surplus		168,919.83
TOTAL LIABILITIES AND SURPLUS		$183,321.65

*By Council action most of general office expenditures in connection with succeeding year were placed on a current basis and charged in current year.

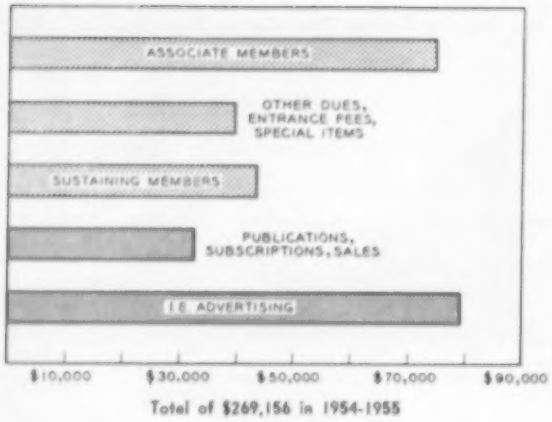


Figure 3. The Society's Financial Support.

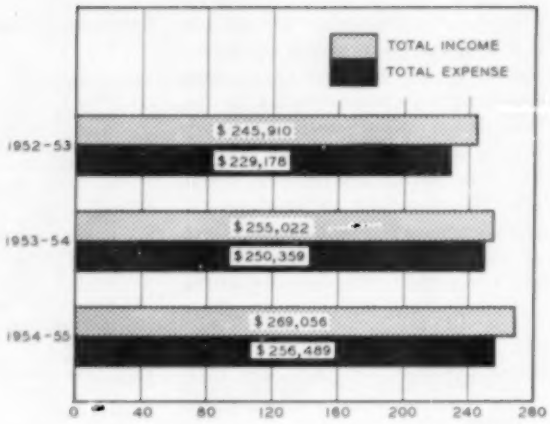


Figure 4. Comparison of Income and Expense.

Committee also reviewed the financial reports for the 1954 National Technical Conference, recommended approval for the budget submitted to operate the 1955 National Technical Conference.

The annual report on the Society's financial condition was presented to Council at the February meeting in conjunction with the annual report of the Treasurer.

A study, started last year, on the costs of services to the membership of the Society was concluded this year by the Committee. This study involved an analysis of staff and headquarters functions leading to an appraisal of the total services of the Society on a per member basis. This analysis was presented to Council and recorded in the Minutes of the February meeting.

Studies continued through the year on the subject of life membership including a review of the practice of other engineering societies.

Fiscal Year Statements — A special study of the auditor's report for the preceding fiscal year was made by the Committee considering certain recommendations as to modifications in the Society balance sheet and statement of income and expense. These changes in the interest of clarification were approved by Council at its February meeting and are reflected in the official auditor's reports for the current fiscal year, included in this report. These figures have been converted to chart form to show the Society's principal sources of income (Fig. 3), the cost of the Society's services (Fig. 5), and the comparison of income and expense for the past three years (Fig. 4).

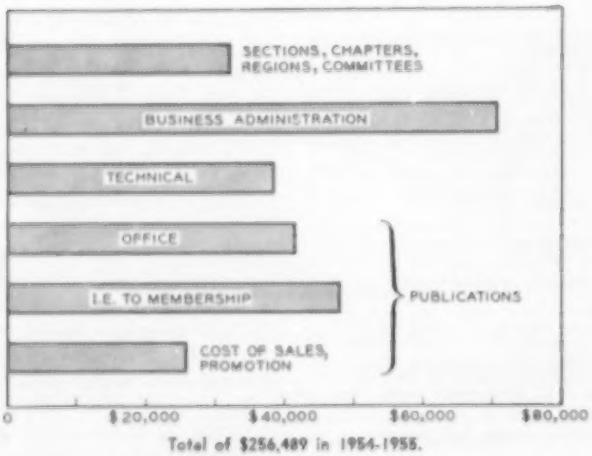


Figure 5. Cost of Society's Services.

Procedures and Policies

The committee with G. W. Beals, Chairman, reviewed a proposed revision of the Society's statement of policy as to privately sponsored social events at National Technical Conferences. The committee's report, accepted by Council at its February meeting, deleted from the Manual of Procedures and Policies the statement of policy adopted by Council in April 1948. The Council then went on record, as follows:

"It is the request of the Society Officers that companies desiring to entertain delegates at the Society's Technical Conference limit such entertainment to their hospitality rooms and that they be open only during hours suggested by the National Technical Conference Committee."

As a result of Council's action at the June meeting, the committee received for study and report the preparation of policy statements on two matters — Publication of Transactions, and Committees.

Constitution and By-Laws

The committee with G. Franklin Dean, Chairman, reviewed a proposed revision of By-Law (b) Section 5 Article II, as had been recommended by the Board of Fellows and approved by Council. Following Council's receipt of the committee's report on the matter, action was taken to reverse the approval of revision previously given, and to continue the By-Law unchanged —

"A Member Emeritus or an Honor-

ary Member shall not be eligible for election to Fellow grade."

The committee was requested to undertake an analysis of the revisions needed in the Constitution and By-Laws, as a result of study of Society procedures and policies made by the General Secretary.

Council, by its action at the June meeting, referred to the committee for a special report, the revision in membership grades and requirements as proposed by the Advance Planning Committee.

Management

Under the Constitution and By-Laws the Council of the Society is charged with managing the affairs of the Society. The Council consists of the officers of the Society, the two most recent Past-Presidents, six Directors and the ten Regional Vice-Presidents. During the past year the Council held the specified five meetings in alternate months beginning in October, and despite the sizable travel distances for some, made an overall attendance record of 65 per cent. With few exceptions, members of Council unable to be present, were represented by proxies. In the months between Council meetings the management of the Society was carried on by Council's Executive Committee, made up of the Society's five national officers.

The affairs of the Society were carried out through the work of its officers and its committees, to whom various responsibilities were assigned. In all cases, however, the ultimate responsibility resided in the Council, and its decisions from month to month were recorded in some 242 pages of minutes.

Each meeting of Council (or the Executive Committee) received and acted upon reports of the General Board of Examiners, the Finance Committee, the Committee on Sustaining Membership, the Committee on Regional Activities, and the General Secretary's report on the receipts, expenditures and liquid assets of the Society.

Regular reports were also received on the membership status, especially in respect to the delinquent members. The Council received regularly at each meeting a report on the Society's Technical Committee program presented by C. L. Crouch, Technical Director.

As the work of other standing, general and technical committees was completed, reports of these projects were received by Council, for approval, and in some cases for approval by letter ballot of Council.

As the first of its special tasks, the Council attended the Annual Meeting of the Society held as is customary in New York on the second Thursday in October. Here a review of the proceedings of the Society was given and Council acted to confirm and approve all the actions of the Society as taken during the previous year.

Two of Council's largest tasks were encountered at its first meeting in October. Here it received the President's recommendations as to the appointment of all committees to serve during the year, and acted upon these. The second task in October was in the consideration of a budget for the year, as developed by the Finance Committee and Council Executive Committee jointly during the previous summer months.

Official action was taken by Council in connection with the following reports of technical committees, during the year:

Industrial Lighting Committee — The report "Lighting of Central Station High Bay Areas."
Color and Illumination Committee — The report "Color and the Illuminating Engineer," Progress Committee.
Nomenclature Committee — The report on Proposed Revisions — 1942 Edition of ASA Z7.1 "Illuminating Engineering Nomenclature and Photometric Standards."
Industrial Lighting Committee — The report "Lighting for Saw Mills — Redwood Green Chain: Part II."
Lighting Design Practice Committee — The report "Calculating Coefficients of Utilization."
Lighting Design Practice Committee — The report "Publication of Room Indices."
Task Committee IES-USPHS — The report "How to Make an Eye Conservation Survey."
Industrial Lighting Committee — The report "Lighting of Central Station Outdoor Areas."
Television Committee, Lighting for Production — The report "Current Lighting Practices for Color Television Production."
IES-ASHAE Joint Committee — The report "Lighting and Air Conditioning."
Office Lighting Committee — The report "Proposed Revision 1947 Edition Recommended Practice of Office Lighting."

Representatives to Other Organizations

The Society continued to maintain relations with other associations and agencies in the fields of science, engineering and standardization through the appointment of official representatives. These included 12 members serving on 18 Sectional Committees of the American Standards Association with C. L. Crouch, Technical Director, serving in each case as alternate representative. Official Representatives were also appointed to the following:

American Association for the Advancement of Science, Governing Board.
Armed Services N.R.C. Vision Committee.
Industry Committee in Connection with the Revision of "Handbook of Interior Wiring Design."
Institute of Traffic Engineers, Joint Committee on Highway Lighting.
Inter-Society Color Council.
Light's Diamond Jubilee.
National Committee on Traffic Safety.
National Committee on Uniform Traffic Laws and Ordinances.
National Lighting Bureau.
National Office Management Association.
National Research Council.
President's Highway Safety Conference.
Society of Motion Picture and Television Engineers.
U. S. National Committee of the International Commission on Illumination.
U. S. National Committee of the International Electrotechnical Commission.

I.E.S. Research Fund

During the past fiscal year the Society continued its relation with the Trustees of the Illuminating Engineering Research Fund under the provisions of the Trust Agreement. In accordance with these provisions Council approved a list of candidates considered qualified for election as Trustees or as members of the Research Executive Committee, to fill vacancies in the two groups resulting from expiration of terms of office. From these nominations the Trustees acted to complete the Board and the membership of the Research Executive Committee with the following serving for the year:

Board of Trustees

A. F. Wakefield, *Chairman*
Franklin M. Foote, *Treasurer*
Conrad Berens — Duncan M. Jones
Willard E. Henges — A. H. Manwaring
Ralph P. Wagner
C. L. Crouch, *Secretary*

Research Executive

E. M. Strong, *Chairman*
Willard Allphin — Dean Farnsworth
R. L. Biesele — Glenn A. Fry
R. M. Zabel

With the presentation of the annual report of the Trustees to Council, C. L. Crouch, Secretary of the Board, outlined the progress on current projects including:

30 — Lighting for Comfort, Dr. Glenn A. Fry, Ohio State University.
30, 30B — Lighting for Seeing, Dr. H. R. Blackwell, University of Michigan.
11, 11B, 48 — Color — A Secret of Good Lighting, Dr. Harry Helson, University of Texas.
37 — Lighting for Highway Safety, Prof. D. M. Finch, University of California.
35 — Improved Lighting Calculations, Dr. R. S. Wiseman, Ft. Belvoir, Va.
22 — Light for Highway Accident Reduction, Prof. J. O. Kraehenbuehl, University of Illinois.
23B — Light for Decrease of Tension, Dr. Leonard Mead, Tufts College.

The results of Dr. Glenn A. Fry's work (Project #17) "The Effect of a Peripheral Glare Source Upon the Apparent Brightness of an Object" have been published in the January 1955 ILLUMINATING ENGINEERING.

Publications

With J. S. Schuchert, Chairman, the activities of the committee were aimed to fulfill its responsibility in accordance with its official scope and were carried out by the several subcommittees in cooperation with headquarters, Miss Ruby Redford, Editor of ILLUMINATING ENGINEERING, and Clayton E. Ellis, Advertising and Sales Promotion Manager. Very satisfactory progress was realized in creating and developing a Publications Committee organization on both a national and a local level. Organization development and financial problems, other general and miscellaneous items are the combined responsibility of the over-all committee and of the staff. Each local Chapter and Section was requested to organize three local committees, on Papers, Sales and Data Sheets.

Editorial Content — R. M. Zabel, Chairman — The subcommittee kept in touch with the editorial content as planned for each issue by the Editor.

Changes and Improvements — John Ronayne, Chairman — Consideration was given to changes and improvements in publications—format, covers, style, etc.

Technical Data Sheets — George T. Anderson, Chairman — For commercial and industrial data sheets, the quota program (a definite requirement or goal for each Section and Chapter) provided material for an outstanding series of data sheets. With Miss Aileen Page as Chairman, the Residential Data Sheet Program was continued as a special part of the data sheet activity.

Research Brochure — John Ronayne, Chairman — Preliminary thinking was continued with respect to the preparation of a research brochure. The subcommittee will follow through on this assignment as soon as certain basic matters and policies are clarified.

Sales, Advertising — H. G. Clum, Chairman — An organization was created (both national and local) and programs developed to increase the sales and distribution of all publications. Display kits, individual regional, section and chapter quotas, and many other sales ideas were discussed.

Consideration has been given and some plans put into operation for increasing the circulation of our magazine, ILLUMINATING ENGINEERING, not only to fulfill more completely our dissemination responsibility but to make our magazine more attractive to present and potential advertisers.

Anniversary Issue — During the year a considerable amount of time was devoted by the editorial staff to the planning and assembling of material for the January 1956 Anniversary issue of ILLUMINATING ENGINEERING.

Standing Committees

Seven Standing Committees are set up by Constitutional provision and reference has been made earlier in this report to the work of three of these — Council Executive, Finance, and Publications. Reports for the remaining four, follow.

Board of Fellows

Henry L. Logan, Chairman

The Board held one meeting during the current year, in April, with ample notice to all concerned ahead of time so that all nominations could be available for processing.

All members of the Board attended. Each member was supplied with complete information on each nominee in advance of the meeting. Twelve nominations for the Grade of Fellow were approved and forwarded to Council for action at its June meeting, along with suggested citations briefly describing the contributions of the nominees.

General Board of Examiners

Clifford Miller, Chairman

The Board met monthly throughout the year and carefully reviewed the applications of all desiring election or reinstatement to Member grade. The Board also reviewed the records of several Members nominated for election to the grade of Member Emeritus.

Medal Award

George S. Crampton, Chairman

The established procedure of this committee calls for a Screening Session between the first and fifteenth of January and a Medal Award Session to be held in advance of the April meeting of Council. This year as a result of comprehensive and detailed preliminary studies of the qualifications of all nominees, including those carried forward from the committee of the previous year, it was found to be feasible to arrive at a unanimous finding at a single meeting in January.

While this action is not offered as a fixed substitute for the established two meeting procedure, certain members of the 1955 committee, living at a distance, found it reduced the expense and loss of valuable time. The unanimous choice of J. L. Stair to be the recipient of the 1955 Gold Medal — highest award of the Society was as pleasing to the committee as we feel it was to the Society in general.

Papers

R. M. Zabel, Chairman

In planning the technical sessions for the 1955 National Technical Conference, the committee reviewed 52 papers in outline. In order to provide a program of wide variety of interest to the many segments of our Society who have specialized interests in the illumination field, the number of parallel sessions in the program was increased. This made it possible to accept 34 papers for the 1955 conference program. Manuscripts of these papers were received, reviewed, approved and set up

Page Content of ILLUMINATING ENGINEERING
October 1954 — September 1955

	No. of Pages
Conference Papers, Abstracts and Discussion	264
Technical Committee Reports	72
General Secretary's Report	18
Other Technical Papers	87
Application Articles	114
Data Sheets	42
Telecast (News Section)	136
Editorials	10
Question and Answers Dept.	8
Committee Personnel, Officers, Sustaining Members	28
Advertising	333
	1,112

in type as conference preprints. Papers were grouped for session presentation, and discussion was organized by those appointed for the purpose.

Last year, one of the highlights of the 1954 Conference was the technical session on "Environment." In view of the success of this approach to conference programming, a session of a similar nature on "Lighting and Architecture" was developed for the 1955 Conference. Again all papers were by invitation, and the authors were selected to give a fresh viewpoint on this very important subject. The following were the three papers in this session:

"Architecture and Our Neglected Senses"
—Eric Pawley, American Institute of Architects, Washington, D. C.
"Interior Color Planning, Is It Aesthetics or Engineering"
—Walter C. Granville, Container Corporation of America, Chicago, Ill.
"Where the Light Leads"
—Douglas Haskell, Editor, *Architectural Forum*, New York.

General Committees

The 16 General Committees of the Society are charged with the operating functions not handled by the Standing Committees, and not pertaining to the preparation of reports on scientific and engineering subjects. The work of three of these has been given in the preliminary part of this report — Procedures and Policies, Constitution and By-Laws, and Regional Activities. Reports for the balance of the General Committees, follow.

Advance Planning

E. M. Strong, Chairman

The committee held four all-day meetings culminating in an extensive report of recommendations to Council at the June meeting.

Three subcommittees served during the year on the subjects of research, Society committees and membership grades. The most extensive contribution was a study recommending the addition of a new membership grade and changes in the requirements for admission to all grades. Suggestions were made regarding dues for the new grade and for a general increase in dues.

Advisory Board to the President

R. F. Hartenstein, Chairman

In connection with the expanding program of the Society and the efforts directed toward increased support from the Sustaining Members, it became evident during the year, that some committee should undertake an evaluation of proposed Society services. This resulted in an Executive Committee recommendation, approved by Council in its April meeting, that the scope of the Advisory Board on Committee Personnel, be enlarged to include this function. The responsibilities of the new Advisory Board were then stated in a revised scope, as follows:

> To examine the organization, accomplishments and assignments of committees and prepare not later than July 1st of each year a proposed list of committees and personnel; and to evaluate costs and benefits of present and proposed Society services.

Acting under the new scope the Advisory Board held one meeting in June preparing recommendations which served to guide the President in the selection of committee personnel and to assist the officers and Finance Committee in the planning of the new administration budget.

Board of Nomination

S. G. Hibben, Chairman

In accordance with the Constitutional provisions and following the procedure adopted by Council, the Board was formed with the three Past-Presidents of the Society and representatives of each of the 10 Regions. The Board reviewed extensive records of candidates as submitted by the respective Regional Nominating Committees, and from these prepared a nomination ticket containing names of those deemed best suited to serve as officers and directors in the positions to be filled at the ensuing election.

Defense Coordinating

A. F. Wakefield, G. D. Mills,
Co-Chairmen

The committee held no meetings during the year. Most of the activities have been carried on by correspondence. A current report on the Projects follows:

#4 — I.E.S. Committee on Lighting for Civil Defense: Work progressing under J. C. Forbes and J. W. Bateman, Co-Chairmen.
#8 — Research for the Bureau of Ships: I.E.S. Research Fund Project #31 in progress.
#9 — I.E.S. Aviation Lighting Committee: Coordination with committee on this project continues.
#12 — I.E.S. Searchlight Committee: Project progressing under committee.
#14 — Illumination and Color Standards for Conservation of Vision: Cooperation in production of leaflet No. 160-6-X for U. S. Air Force.
#15 — I.E.S. Committee on Lighting for Civil Defense, Technical Booklet Subcommittee, R. B. Brown, Jr., Chairman, cooperated with Federal Civil Defense Administration in preparation of Conillum Technical Manual.

There has been no active solicitation for the expansion of the committee's work during the past year, but the members of the committee stand in readiness to support the offer made by the Society from time to time to the Armed Services and the various Defense agencies.

Historical

S. G. Hibben, Chairman

During the year the committee kept in touch with the plans for the Society's Golden Anniversary Conference to be held in Boston, September 1956. One report was presented to Council suggesting special organization of the Conference sessions. The committee also recommended the appointment of a Golden Anniversary Committee which might handle the special activities pertaining to the Anniversary celebration, including the design and distribution of anniversary medallions and stickers.

The committee also presented in a report to Council a draft resolution in connection with the 1956 Celebration of the 250th Anniversary of Benjamin Franklin's birth.

Lighting Service

L. E. Tayler, Chairman

The My Most Interesting Lighting Job Contest continued to be the principal activity of the committee again this year, in view of the sustained interest of the members. Changes in some of the rules were approved by Council. These were mainly in the area of liberalizing publication rights of contest entries. The local contest committees completed early plans resulting in all but 18 of the Society's Sections and Chapters scheduling contests.

The Lighting Service Forum held in conjunction with the National Technical Conference consisted of the national contest of regional winners. All regions were represented. The winners receiving certificates and cash prizes at the annual banquet were:

First Prize — George C. Schroeder, Jr., New Orleans Section.
Second Prize — Harold Fisher, Michigan Section.
Third Prize — H. M. White, Maryland Section.
Fourth Prize — Gordon L. Dovey, Southern California Section.

Membership

T. W. Lauer, Chairman

The organization of the membership activity was changed somewhat this year with the idea of holding present members as well as securing new ones.

The gain part of the program was the same as last year with the Sections and Chapters being divided into four groups. The total gain was 1173 new members which was close to our goal of 1200.

The winners in the gain part of the campaign were as follows:

Group I — Northern California
Group II — Georgia
Group III — Oil Capital
Group IV — Maritime

The low-loss part of the campaign was new this year and produced very interesting results. In past years, the over-all gain was reduced considerably by loss of members due to non-payment of dues. In the low-loss part of the campaign the delinquent members and resignations were brought to the attention of each Section and Chapter early in the year.

The winners for the low-loss part of the campaign were as follows:

Group I — Michigan
Group II — Twin City
Group III — Rocky Mountain
Group IV — Ark-La-Tex and Palmetto with perfect scores of no losses at all.

Winners in both groups received their prize checks at the National Technical Conference in Cleveland.

Assistance was given the local committees through ample supplies of application forms, promotion folders and monthly reports showing the standings of each Section and Chapter in the campaign.

National Technical Conference

Charles N. Laupp, Chairman

The committee reviewed the plans and budget for the Conference in Cleveland, September 12-15, and recommended on these to Council.

Consideration was given to some of the planning for the 1956 Golden Anniversary Conference to be held in Boston, especially in connection with the financing of special Anniversary functions and the holding of an historical lighting exhibit at the Conference.

The Committee also reviewed a proposed revision of the Society's statement of policy on the subject of entertainment at National Technical Conferences, and as noted earlier, the report of the Procedures and Policies Committee on this revision was accepted by Council.

Revised dates for the 1958 National Technical Conference in Toronto, Canada, as recommended by the Canadian Regional Vice-President, were considered by the committee, and recommended for Council's approval. The committee also reviewed proposals in connection with the 1959 Conference and recommended that Council approve its location in San Francisco.

Conference Registration Records

1944	Chicago, Illinois	721
1945	No Convention	.....
1946	Quebec, Quebec	807
1947	New Orleans, Louisiana	605
1948	Boston, Massachusetts	906
1949	French Lick, Indiana	668
1950	Pasadena, California	556
1951	Washington, D. C.	765
1952	Chicago, Illinois	859
1953	New York, New York	1,007
1954	Atlantic City, New Jersey	851
1955	Cleveland, Ohio	754

Public Relations and Information

J. F. Whitehead, Jr., Chairman

Two meetings of the committee and four subcommittee meetings were held in carrying out an extensive program under the general plan adopted in 1949. Attention was given to the internal relation with the Society membership as well as external to the lighting and electrical industry and to the public. The activity has been carried onby headquarters personnel at the national level and in practically every Section and Chapter at the local level. Each local committee was again equipped with a manual of instructional and publicity material.

The principal effort toward the membership is the series of President's News Letters this year sent on three occasions to over 1000 local and national officers and committee chairmen. Press releases at the local and national level, as well as at the Regional Conferences are the principal means for external publicity. The Guide for Publicity at Regional Conferences was again circulated together with special material for publicity incident to the President's attendance at each Conference.

The committee also reported recommendations to Council at its February meeting, in connection with the publication and mailing of a news sheet to the whole Society membership, one of these issues to be devoted to a "Report to the Membership," required by Council's policy action in 1954. The committee also reported recommendations as to the 50th Anniversary Celebration program, and revisions in the rules "precluding prior publicity," governing the Most Interesting Lighting Job Contests.

Residence Lighting Forums

Mary B. Taepke, Chairman

Two meetings of the committee were held — one in Detroit and one in New York City. The major responsibility consisted of planning the annual program for the National Conference.

The five Forum groups represented by Georgia, Tennessee Valley, New York, Michigan and Chicago have expanded to include a group from Utah. Newly organized as of early winter 1955, the Utah Forum reported three breakfast meetings with a total attendance of 59.

A reported total (minimum) of 1,806 men and women attended Forum meetings in these six sections. Allied Residence Lighting subjects discussed at the meetings included Architectural Lighting Design, Portable Lamps, Wiring, Built-in Lighting Elements, Decoration and Lighting for Pictures and Fine Arts. Field trips are gaining in popularity and Garden Lighting has enjoyed a very prominent position in four of the groups.

The following data briefly summarize each Forum group. Featured is just one meeting selected at random because of attendance, long-range interest or other unusual factors:

Name	Membership	Meetings Reported	Outstanding Program
Tennessee Valley	45	7	Christmas Lighting Exhibits
Michigan	91	5	Home Lighting Workshop
New York	184	6	High School Design Competition
Georgia	80	5	Series of Meetings on Garden Lighting
Chicago		1	Field Trip to Lighting Demo Home
Utah		3	New Trends in Residence Lighting

Sustaining Membership

C. C. Shotwell, Chairman

The committee's activity this year was more fruitful than that of the past several years. The committee this year directed a considerable amount of its effort towards cementing the relations of the Society with sustaining members by making them more aware of the Society's present and long-range objectives. There was a marked in-

crease over last year in the number of Sections and Chapters who contributed to the work of the committee. Last year only 8 Sections and Chapters obtained new sustaining members or increases, whereas this year 26 Sections and Chapters made the honor roll with top honors going to Chicago and Oregon. The standings of the Sections and Chapters in the new member and dues increase drive are:

Group I Quota 6

	Elections and Increases	Per Cent of Quota
Chicago	6	100
Cleveland	2	33⅓
Golden Gate	2	33⅓
Michigan	1	16⅔
New England	1	16⅔
New York	3	50
Philadelphia	1	16⅔
Toronto	2	33⅓
Pittsburgh, Southern California		0

Group II Quota 4

	Elections and Increases	Per Cent of Quota
Central New York	1	25
Connecticut	2	50
Georgia	1	25
Heart of America	1	25
Milwaukee	2	50
Montreal	1	25
St. Louis	2	50
Southwestern	1	25
Twin City	1	25
Eastern Pennsylvania, Puget Sound, Tar Heel		0

Group III Quota 3

	Elections and Increases	Per Cent of Quota
Arizona	1	33⅓
British Columbia	1	33⅓
New Orleans	2	66⅔
Ohio Valley	1	33⅓
Oregon	4	133⅓
21 other Sections and Chapters		0

Group IV Quota 2

	Elections and Increases	Per Cent of Quota
Maritime	1	50
Miami Valley	1	50
New Mexico	1	50
Oil Capital	1	50
17 other Sections and Chapters		0

Following the practice of the past several years, the President's News Letters were again sent to each official representative. Progress has been made in the preparation of a Brochure which will be available for next year's committee. This Brochure will graphically outline the many advantages which the entire industry derives from the work of the Society. It will also describe past and current research projects and outline the future plans of the research program.

The following tabulation shows the results of this committee's efforts over the past eight years.

Sustaining Members for Past Eight Years

	Members	Dues Income
1948	326	$30,209.37
1949	316	40,335.00
1950	316	40,235.00
1951	316	40,793.00
1952	335	41,735.00
1953	334	40,735.00
1954	336	40,635.00
1955	334	43,391.50

Trustees, I.E.S. Headquarters Retirement Pension Plan

E. M. Strong, Chairman

In line with customary practice since the inauguration of the Plan in 1950, the four Trustees appointed to serve during the fiscal year included the Treasurer of the Society, the Chairman of the Finance Committee, and the two immediate Past-Presidents. Official business was transacted by correspondence except for the formal actions recorded by the Trustees at their annual meeting held during the Cleveland Conference. During the year 11 of the 18 members of the headquarters staff were eligible and participated in the Plan.

Task Committees

Golden Anniversary Task Committee

W. C. Brown, Chairman

At the February meeting Council approved the appointment of this Task Committee to assist in the planning of a comprehensive anniversary program and to suggest and coordinate plans undertaken by the Society committees.

At the close of the fiscal year the Task Committee had completed a report to be presented to the October Council meeting, incorporating recommended suggestions, commenting on controversial suggestions and reporting a number of suggestions not approved or not fully considered.

Headquarters Planning Task Committee

Kirk M. Reid, Chairman

The appointment and scope of this Task Committee were discussed at two meetings of the Council Executive Committee during the year, resulting in the recommendation, approved by Council in February, that the committee have the following scope:

> To study and recommend to Council plans for Headquarters location and space requirements both short-range 1955-approx. 1959) and long-range (approx. 1960-1970), taking into account prospective needs of Headquarters personnel, and also to study Headquarters operation in accordance with the Advance Planning Committee Recommendation of having an understudy for each senior staff member.

The recommendations of the committee as to the renewal of a lease in the present headquarters location also were approved at the February Council meeting, including the provision of air conditioning.

Society Dues Task Committee

D. M. Jones, Chairman

In its action at the June meeting on the report of the Advance Planning Committee, Council included the appointment of a Task Committee to study the recommendations as to increase in individual membership dues. This committee with representation from the Society's Committees on Membership, Sustaining Membership, Regional Activities, Finance, and Public Relations and Information, met at the Cleveland Conference and prepared a report which was to be submitted at the first meeting of Council in the new fiscal year.

Tellers

Richard S. Wissoker, Chairman

In accordance with Constitutional provisions the committee met following the close of the election ballot and counted the vote both on the national and Section offices. In this the committee had the customary assistance of headquarters personnel both in the preparation of the forms and reports, as well as in the opening of the ballots and making of a preliminary count.

IES-US Public Health Service

J. F. Parsons, Chairman

The assigned project for this committee, the preparation of material for a publication "How to Make an Eye Conservation Survey", was accepted as a progress report by Council at the June 1955 meeting. The report is divided into two parts: Illumination, prepared by members of the USPHS and the IES, and Vision, prepared by physicians of the USPHS. An official of the USPHS and a private consultant in industrial health were present at Council meeting to urge early publication of the report for use by United States Public Health Service field engineers and by consultants. The

report was referred to the Publications Committee for analysis and advice to Council at an early date on the feasibility of publication.

Technical Committees

The Constitution provides for the establishment of technical committees to report upon scientific and engineering subjects. The technical committee activity was overseen by R. F. Hartenstein, Senior Vice-President, who was active in counseling and in following progress. The work was carried out by C. L. Crouch, Technical Director, and his associates at headquarters. Scheduled again this year was a two-day Technical Forum bringing together for a most successful meeting the chairmen of all technical committees. The forum proved to be a profitable interchange of committee experience, problems and planning, also serving as an excellent orientation for both old and new chairmen. Reports of the several committees on the year's program follow.

Aviation Lighting

D. C. Miller, Chairman

The committee again held two conference type meetings, each of two days' duration, one at Williamsburg in November and one in New York during April. At the Fall meeting two panels were conducted — one on helicopter lighting and on marking and lighting of tall obstructions. Papers were presented on helioport lighting, runway lighting, visibility studies, and the C.A.A. Airport program. At the Spring Conference, formal papers were presented on helicopter lighting, marker lights and high speed aircraft, transport carrier lighting, and current airport lighting problems.

Civil Defense, Lighting for

J. W. Bateman, J. C. Forbes, Co-Chairmen

Coincident with the announcement of the "Conillum" plan for the control of illumination in the Continental United States, the Society received a formal request from Mr. Val Peterson, National Federal Civil Defense Administrator, for assistance in preparing technical material for a manual to be used in implementing the plan. Accordingly, a special task group, the Technical Booklet Subcommittee, was created and which, in March 1955, turned over to FCDA a suggested outline and first draft of material for such a booklet. FCDA staff writers proceeded with the project, referring back to the IES Committee for review and criticism of the technical material. Meanwhile the subcommittee is on a stand-by basis.

Color and Illumination

R. C. Allison, Chairman

The committee's report "Color and the Illuminating Engineer," was submitted to the October meeting of Council and accepted for letter ballot. Another report "Guiding Principles in the Use of Color," was reported to Council for transmittal to application committees concerned with lighting of offices, schools, institutions, and industrial interiors. Subcommittee meetings were continued through the year.

Daylighting

Robert A. Miller, Chairman

The committee met at Atlantic City at the time of the 1954 Technical Conference, with some seventeen members of the committee and C. L. Crouch, Technical Director, in attendance. At this meeting, a number of subcommittees were appointed: Measurement of Daylight, Dr. E. E. Vezey, Chairman; Coordination of Daylighting Interests with other I.E.S. Committees, Dr. Robert A. Boyd, Chairman; Low Ceiling Classrooms, H. F. Kingsbury, Chairman; Availability of Daylight, B. F. Greene, Chairman. There were again seventeen members of the committee, Mr. C. L. Crouch and Dr. Gunnar Pliejel of Stockholm present at a meeting of the committee held at the Mellon Institute of Industrial Research in Pittsburgh, on March 7. A. A. Brainerd discussed the functioning of the C.I.E. (Commission Internationale de l'Eclairage). Prof. Paul W. Seagers, University of Indiana represented the U. S. National Committee on Daylighting at the C.I.E. meeting in Zurich. Dr. Pliejel gave a most interesting talk on lighting design practice for the utilization of daylight in buildings in Sweden. Dr. Robert A. Boyd reported briefly for his Subcommittee on Coordination of Interests, which was somewhat amplified by Mr. Crouch, mentioning several committees which have special interests in Daylighting.

J. W. Griffith, the only member of the Subcommittee on Availability of Daylight, speaking for Mr. Greene, reported progress in compilation of data. Acting for Dr. E. E. Vezey, Mr. Griffith reported extensive review of the literature on Measurement and Reporting on Daylighting of Interiors, resulting in the subcommittee considering two different methods, one of which is simple and reliable, while the other is reliable and comprehensive. Mr. Kingsbury presented a comprehensive written report on the activities and progress of his Subcommittee on Low Ceiling Classrooms. A Subcommittee on Brightness Ratio Measurements was appointed with W. J. Arner as chairman. This subcommittee is to cooperate with the Committee on Standards of Quality and Quantity for Interior Illumination.

Design Practice

B. S. Benson, Jr., Chairman

The scope of this committee was to study published data on coefficients of utilization, room indexes, maintenance coefficients and other elements entering into calculations for lighting design; develop standard methods for use in Society publications and report thereon.

The actions of the committee were as follows:

Appendix to the 1953 report of this committee to Council. This report, approved by Council in October, 1953, adopted the Zonal Factor Interflectance Method as the preferred method of calculating coefficients of utilization for interior luminaires. No procedure was included in this report and the committee, this year, completed and sent to Council an Appendix giving a step-by-step procedure for calculating coefficients of utilization under the new method.

Simplified procedure for Zonal Factor Interflectance Method. A simplified procedure for calculating direct component coefficients of utilization has been adopted as an alternate procedure by the committee and awaits completion of details. A simplified procedure for calculating indirect components coefficients of utilization is under study.

Basis for coefficients of utilization for processed lamps and equipment. The committee recommended to Council that all photometry and coefficient of utilization data for processed lamps

and their equipment be based on actual lamp lumens and that lamp manufacturers make such data available.

Room ratio calculations. The committee has under study the possible revision of the present system of calculating room ratios. In view of a possible conflict in the industry regarding room ratios, a series of resolutions, acting as a guide to further study, were sent to Council.

Floodlighting Calculations. The responsibility of the study of illumination calculations for floodlighting was accepted by the committee and is now under study.

Education

H. H. Magdsick, Chairman

Two subcommittee reports are currently before the committee for review and approval. One is the second draft of a comprehensive revision of "Experiments with Light" for use in secondary school physics classes. The other is a second report from the Subcommittee on Employment Potential for Professionally Trained Illuminating Engineers. There is a wide and growing demand for such personnel, but employers have failed to make their needs sufficiently known to the administrators of our technical schools.

The Subcommittee on Curriculum strongly urges that an introductory course in Illuminating Engineering in the sophomore year be a requirement of all electrical engineering students. This is necessary to enable students to make an informed choice of the field for which they wish to prepare. Two further years of specialization—in the 3rd and 4th or the 3rd and 5th year—are deemed necessary for the training of competent illuminating engineers.

The discouraging trend in attention given illuminating engineering by our technical schools is reflected in the fact that four of the eight Student Branches of the Society have become inactive. In marked contrast is the sustained program of specialization in this field reported by the Russian delegation at the plenary session of the Commission Internationale de l'Eclairage in Zurich in June of this year. Comprehensive training in illuminating engineering has been provided at the engineering school in Moscow for the past 20 years in a 5½-year curriculum. Fifty new students are enrolled in this program each year.

Farm Lighting

O. C. Lange, Chairman

The committee held one meeting during the year in Harrisburg to take action on two projects:

1. Late in 1954 the committee mailed to a list of agricultural extension personnel throughout the nation and its possessions a copy of the "Recommended Practice for Residence Lighting." The response to this mailing was extremely gratifying. Therefore, the committee has decided to make a similar mailing in September of this year of the "Revised Farmstead Wiring Handbook" which is expected to be off the press late in August or early September. As mentioned in last year's report, our committee was instrumental in revising the recommended lighting outlet layouts in this handbook.

2. Since this committee had an active part in the revision of the "Farmstead Wiring Handbook" it was thought advisable that the committee prepare a lighting handbook which would recommend types of luminaires and equipment to be used for the various lighting applications listed in the wiring handbook. The committee plans on having this handbook completed by early Fall of 1956.

IES-ASHAE Joint Committee

Walter Sturrock, Chairman

The report entitled "A Study of the Thermal Aspects of the Lighting System, Part I—Its Relation to the Cooling Load" has been prepared. Copies of it were submitted early in June to the ASHAE Cooling Load Committee and to the Council of the Society. Both groups have indicated their approval but plans for publication are pending.

The report includes the results of three separate projects:

(a) A bibliography of related subjects.

(b) A list of pertinent questions and answers regarding lighting and air conditioning practices.

(c) Proposed research activities for information and data to supplement present knowledge.

Illumination Performance Recommendations

B. S. Benson, Jr., Chairman

The scope of this committee was to prepare illumination performance recommendations for luminaires conforming to C.I.E. classifications, excluding residential.

Following its proposed intention of last year, the committee submitted to the Illuminating Engineering Research Fund a recommendation that a project be established to develop the following information:

1. Verify the average brightness concepts that are now being proposed to evaluate visual comfort in areas involving critical seeing tasks such as offices, schools and industrial work areas.
2. Determine the relationship of maximum brightness as may appear in small areas of a luminaire vs. the average brightness of the luminaire.

The committee has offered its services in an advisory capacity to the Fund. In line with this, all available committee members met with the Technical Advisory Committee on Light and Vision to discuss the problems to be encountered in such a study.

Industrial Lighting

W. P. Lowell, Jr., Chairman

This committee was re-organized during the middle of the year, and held one meeting to review progress of its subcommittees. One subcommittee—"Lighting of Central Station Properties," L. G. Parks, Chairman, submitted its report on "Lighting for Outdoor Areas," and this was submitted to Council and approved.

A new committee, Outdoor Production Areas, organized and started studying railroad yards.

The Graphic Arts-Printing Industry Committee studied intensively the lighting for color appraisal and made measurements of visibility of composing room tasks.

Some of the other subcommittees reported progress, while some were inactive. The committee decided that its chief function for the balance of the year was to stimulate the subcommittees wherever possible.

Institutional Lighting

James H. McCullough, Chairman

Subcommittee — Commercial Kitchen Lighting—Carl W. Zersen, Chairman. As the result of frequent meetings of this committee, centered in the Chicago area, a report was completed for submittal to a meeting of the main committee during the Conference in Cleveland. The report included details as

to recommended illumination levels, color temperature of light sources, brightness controls and other related factors.

A joint meeting was held with the Chicago Section of the National Restaurant Association to exchange views and opinions.

Subcommittee — Lighting in Hospitals — William H. Smith, Chairman. The principal activities of the year have been toward preparation of material for lighting in the Hospital Kitchen, Laundry, Pharmacy, Laboratory, Examination, Operating, Delivery, and Patient's Room. All material will be planned for compilation into recommendations for lighting of each of these areas.

The committee anticipates having some of this data available in draft form for preliminary editing by the first of next year.

Subcommittee—Lighting in Theatres—Joel E. Rubin, Chairman. The committee has initiated two projects during the year. The first, concerned with lighting of school theatres and auditoriums, is in its preliminary phases, and no publishable data is expected to result for several months. The second, concerned with the specification of lighting instruments for theatre, television and motion picture production, is under extensive investigation. This project is being carried out with the cooperation of the Society's Television Lighting Committee and the S.M.P.T.E. Television Committee. A report on the specification of lighting instruments should be ready for submission for publication within the next few months.

Light Control and Equipment Design
David L. Williams, Chairman

The committee reports progress on its principal assignments as follows:

1) Publication in the February 1955 issue of ILLUMINATING ENGINEERING of a "Table of Materials and Finishes for Light Control."
2) Addition of a subcommittee to consider aluminum, William Weibel, Chairman.
3) Subcommittee on Plastics (Joint IES-SPI-NEMA), F. C. Winkler, Chairman, has membership representing testing laboratories and the lighting and plastics industries. The subcommittee's interest is covered by three subcommittees considering: A) General Requirements, B) Properties and Measurement, and C) Maintenance. The subcommittee is considering revision requirements of the plastics section of the above "Materials Chart."

Light Sources
H. F. Davidson, Chairman

The committee reports the following progress for the year.

1. The question and answer page has been continued in ILLUMINATING ENGINEERING as a method of conveying light source data to the membership.
2. Work is progressing on a report dealing with the effects of high and low ambient temperature and drafts on the color, starting and light output of fluorescent lamps. It is expected that this report will be completed in 1956.
3. A subcommittee under the chairmanship of Miss Dorothy Nickerson is working on the development of a method of measuring and specifying the color rendition properties of light sources. The subcommittee has made visual and calculated appraisals of the color rendition of some fluorescent lamp colors for a number of color samples. At the present time checks are being made to obtain the reason for some inconsistencies between the visual and calculated results.
4. A subcommittee, C. L. Amick, Chairman, is working on light source nomenclature in order to recommend definitions of lamps and accessories to the Society's Committee on Nomenclature.

Lighting Maintenance

The program of this committee was interrupted during the year by the resignation of the committee chairman. Members of the committee continue the principal committee projects including perfection of the Dirtometer and the collection of data as to the dirt carrying qualities of various atmospheres.

Motor Vehicle (Exterior) Lighting
Ray P. Teele, Chairman

This committee was reactivated in 1953 at which time the S.A.E., the National Committee on Uniform Traffic Laws and Ordinances, and the Defense Department were all getting out final recommendations of which this committee needed to take cognizance in its work. The last of these groups made its final report in October 1954.

With these related recommendations available the committee chairman proceeded with a first draft of a Recommended Practice of Motor Vehicle (Exterior) Lighting which was discussed at a meeting during the Conference in Cleveland. This first draft of a recommended practice embodies the ideas of the committee members, expressed to the chairman, and is also based on the discussions at meetings of the various committees of the other organizations attended by many members of the Society's committee who also serve on their committees.

Nomenclature
Priscilla Presbrey, Chairman

The committee is making slow progress toward a sorely-needed revision of ASA Z7.1-1942, Illuminating Engineering Nomenclature and Photometric Standards. Two recommendations of the committee which were this year approved by Council are definite steps in that direction:

1. A completely rewritten version of Section 30, formerly called Materials and Accessories Modifying Distribution of Light but now more appropriately titled Characteristics of Surfaces and Media for Controlling Light. This new section had been very nearly completed and approved by the 1953-1954 committee, but was not submitted to Council until this year.

2. An addition to the definition of Photometric Brightness (Luminance) which makes it more of a generalized concept. With this change it was agreed that Sections 05 and 10 as approved in 1950 are reasonably satisfactory to the present committee and will require no further revision for the new edition of the Nomenclature.

A subcommittee appointed by the Light Sources Committee is working on a revision of Section 25, Light Sources, revisions of the sections on Color and on Ultraviolet and Infrared Radiation are under consideration, and a first draft of a new Section 60 on Light and Vision has been prepared.

The committee has also been in touch with the nomenclature groups of the International Commission on Illumination and the International Electrotechnical Commission, and has had an opportunity to comment on material prepared by them.

Office Lighting

John J. Neidhart, Chairman

The committee reconsidered its revision of the Recommended Practice of Office Lighting in accordance with the instructions of Council. Liaison work with School Lighting Committee representatives resulted in a few basic changes, and other minor editorial changes were made. The final revision was submitted to Council at its June meeting where it was accepted for letter ballot.

Progress

E. W. Beggs, Chairman

The committee maintained contact with the art of lighting throughout the world and prepared the yearly review of the achievements in the art of lighting for publication in ILLUMINATING ENGINEERING. This review was given a dramatic presentation as one of the features of the 1955 National Technical Conference in Cleveland.

Protective Lighting

J. W. Lee, Chairman

The committee is awaiting approval of its report the American Standard "Protective Lighting for Industrial Properties A-85, 1952."

Public Conveyances, Interior Lighting

Carl E. Egeler, Chairman

The Subcommittee, Lighting for Land Transportation, completed a valuable revision of the Association of American Railroads Manual of Recommended Practice data on lighting. It now becomes a new section titled, Illumination, providing up-to-date information on lighting practice for passenger-carrying rolling stock. Its acceptance by the railroad group's personnel was enthusiastic.

The Marine Lighting Subcommittee has nearly completed its report on Recommended Practice for Merchant Ship Lighting, and is assembling photographs to be incorporated in the technical material, all in the form required for submission to Council, and later publication.

Research Planning

Willard Allphin, Chairman

The committee operated on a stand-by basis pending the analysis at headquarters and publication of the survey of colleges and universities determining interest in research on light and vision and lighting research in process.

Residence Lighting

Frank J. Marriett, Chairman

The committee work was coordinated through four scheduled committee meetings during the year. Work was continued on two major projects carried over from last year, and two new projects started. Activities were as follows:

1) Subcommittee on "Outline for Training Program" was enlarged and strengthened and will continue to develop outline designed for use by study groups and other interested organizations wishing to offer training programs on Residential Lighting.
2) Dormitory Study Room Survey has been summarized and report prepared. Participating colleges and universities are being advised of the results of the survey and committee is studying the summarized report to plan further action.
3) New subcommittee established on "Portable Lamps — Measurement of Characteristics of Performance." Basis for Measurements has been established and tests are proceeding.
4) Subcommittee "Contemporary Lighting in Modern and Traditional Interiors" is underway to review and revise title. Publication to be ready for print at time present edition is depleted.

School Lighting

J. M. Chorlton, Chairman

During the year two meetings were held with representatives of the School Committee of the American Institute of Architects and the National Council of Schoolhouse Construction, co-sponsors of the American Standard Practice of School Lighting. Deliberations were directed toward securing agreement on the principles involved in the revision of the 1948 American Standard Practice. The studies included brightness limitations of luminaires for direct glare, and reflected or specular reflection. The resulting recommendations were considered by the complete committee and referred also for consideration by the Society's Committee on Office Lighting.

Searchlight

Theodore H. Projector, Chairman

Two meetings of the committee have been held, in January and in June, at which several interesting papers were presented. Subcommittee activity has gotten well under way and should result in a steady increase in output of reports and other useful data.

Bibliography, J. P. Latil, Chairman. Two bibliographies on searchlights have been compiled and issued, and a third edition is in preparation.

Auxiliaries, H. N. McIntyre, Chairman. Data are being collected on the various aspects of auxiliary equipment used on searchlights, such as power supplies, mechanisms, controls, etc., for compilation in reference form.

Light Sources, J. A. Bartelt, Chairman. A "Light Source Data Sheet" is being prepared, containing comprehensive information on all types of light sources, for use in the design of searchlights.

Visibility of Targets, A. H. Clarke, Chairman. It was hoped that a guide might be developed that would contain basic tables and charts for use in the solution of problems in this area. It has been found, however, that the complexity of the subject makes it difficult to generalize information. Study of the literature and of the practicability of the issuance of guides is continuing.

Visibility of Sources, W. A. Pennow, Chairman. Available data is being compiled and studied, and consideration is being given to issuance of reference information.

Optics, D. H. Peterson, Chairman. Studies of reflector-light source combinations and of searchlight door covers are under way, and a study of reflector manufacturing processes is under consideration.

Testing Procedures, T. I. Monahan, Chairman. This subcommittee is collaborating with the Society's Committee on Testing Procedures for Illumination Characteristics which has prepared a guide for the testing of searchlights.

Nomenclature, E. Boghosian, Chairman. A preliminary list of searchlight terms and definitions has been compiled and is now circulating among members of the committee for comment.

Signal Lighting, Elements of

F. C. Breckenridge, Chairman

Further progress has been made with

the preparation of manuscripts for the Elements of Signal Lighting.

Sports and Recreational Area Lighting
Merle E. Keck, Chairman

The work of this committee is principally concerned with the review of a draft of a proposed addendum to the Recommended Practice for Sports Lighting covering eighteen additional minor sports.

Standards of Quality and Quantity for Interior Illumination
Sylvester K. Guth, Chairman

Efforts continued toward the development of a definitive report to bring up to date Committee Report No. 1 "Brightness and Brightness Ratios." Various proposed methods of calculating comfort-discomfort appraisals are being compared and evaluated in order to resolve differences among them.

Store Lighting
C. M. Cutler, Chairman

The committee held two meetings during the year with particular attention to producing a Store Lighting Guide. It was decided that this would be the first order of business rather than the final revision of the present "Lighting Practice for Stores and Other Merchandising Areas." A copy of the outline was sent to members for further study and suggestions. A final outline was prepared after the second meeting at which time various sections of the outline were assigned to various members to put in draft form. Part of this has been accomplished and sent to all members for comment. The drafts received so far all represent a good deal of work, and the members of the committee look forward to the consolidation of the material before proceeding with illustrations and final draft.

During the year a subcommittee of the Store Lighting Committee has been formed. It is called, "Lighting of Service Stations and Parking Areas Subcommittee of the Store Lighting Committee." This is under the chairmanship of E. H. Schaefer, who is beginning to get the work and objectives outlined and organized.

Street and Highway Lighting
Charles H. Rex, Chairman

Progress in this committee's assigned objectives and responsibilities is as follows:

Recommended Practice of Parking Area Lighting has been prepared by the project Subcommittee and Chairman, W. H. Edman. This has been submitted to the committee for review. The proposed recommendation will be negotiated with the Store Lighting Committee with the objective of producing a joint report on Parking Area Lighting which later will be submitted to Council for approval.

Lighting for Tunnels and Underpasses has been completed by the project Subcommittee, R. M. Swetland, Chairman. Most of the committee members have approved the report. It is scheduled for submission to Council.

Traffic Sign Lighting. Current practice in the application of lighting for traffic control signs will be illustrated by a pictorial report prepared by a subcommittee, Henry W. Osborne, Chairman. Members of the Institute of Traffic Engineers and the American Association of State Highway Officials have cooperated by submitting exhibits of good practice which will aid public and private agencies in handling night traffic problems. This report is scheduled for completion and submission to the committee.

Visibility Under Fog Conditions. Appraisal of the visibility effectiveness of roadway lighting during fog conditions has been the primary purpose of a subcommittee activity headed by Mr. Ellis Paul, a committee member who is also consultant for several large Turnpike Authorities. With the aid of the I.E.S. Research Fund Technical Advisory Committee and C. L. Crouch, the problem of visibility under fog conditions has been delineated for the I.E.S. Research Fund Committee. Projects have been established whereby universities will investigate methods for improvement of night visibility, its measurement and evaluation under fog conditions. To the $1,000 contributed by the Research Fund, nearly $9000 has been contributed by agencies such as the New Jersey, Pennsylvania, New York, Massachusetts, and Garden State Turnpike Authorities ,Delaware Inter-State Highway Commission and the Port of New York Authority, and manufacturers. Actual work on this important problem started during October and November 1955.

Mercury Vapor Lamps. Considerable progress has been made by this subcommittee under John Young. Mercury vapor lamp ratings and performance data have been compiled such as may be essential in the application of A.S.A. lighting on streets and highways. A report has been completed which will include data on horizontal lamp operation. This investigation has already accomplished much of benefit to those seeking authentic information.

Evaluation of Seeing with Roadway Lighting. The committee has enlisted the aid of the I.E.S. Research Fund Technical Advisory Committee on Light and Vision in the evaluation of factors in seeing under roadway lighting. They are actively working on the development of instruments and procedures for overall appraisal of both seeing comfort and visibility with roadway lighting. Completion of this work will aid the Fluorescent Subcommittee make progress in appraisal of large low-brightness luminaires. This has been aided by a list of questions prepared by the Research Subcommittee. The committee has suggested through Mr. Crouch that evaluation of large, low-brightness luminaires be included in I.E.S. Research Fund Project No. 37 "Investigation of Factors Influencing the Night Visibility of Roadway Obstacles" now being conducted by D. M. Finch.

Television — Lighting for Production
R. L. Zahour, Chairman

The committee continued its 1954 project, "Current Lighting Practices for Color Television Production" and a final report approved by committee members was submitted to Council in May.

As a sequel to this project, in the Fall of 1954 the committee recommended a study of television lighting equipment performance ratings, with the aim of establishing a uniform standard for rating equipment performance. To aid in this study, the committee accepted an offer of joint cooperation from H. M. Gurin, Chairman of the SMPTE Television Lighting Committee.

Three subcommittees were set up to conduct this project: a Subcommittee from the Society's committee; a Subcommittee of the SMPTE Television Committee; and a Subcommittee from the Society's Theatre Lighting Committee. In February of 1955, the three subcommittee chairmen met to outline the work for the equipment performance project. A meeting of the three subcommittee chairmen with this committee is planned to hear a progress

report on the project. It is expected that the study will continue well into 1956.

Testing Procedures for Illumination Characteristics

Kurt Franck, Chairman

Progress of the committee's work on its principal assignments was as follows:

(1) "General Guide on Photometry" –Subcommittee Chairman R. P. Teele. Excerpts of guide published in ILLUMINATING ENGINEERING March and April 1955. Full report being printed as separate publication.

(2) "Practical Guide on Photometry" — Subcommittee Chairman O. P. Meaker — in preparation by Subcommittee.

(3) "Guide on Photoelectric (Portable) Photometers" — Subcommittee Chairman G. A. Horton. Revision of 1937 report in progress.

(4) "Guide for the Photometric Testing of Outdoor Fluorescent Luminaires" — Subcommittee Chairman J. S. Franklin. Proposed guide approved by Subcommittee, submitted to entire committee for approval by letter ballot.

(5) "Guide for Photometry of Searchlights" — Subcommittee Chairman A. E. Krawcek. Proposed guide submitted to Society's Searchlight Committee for review.

(6) "Guide for Electrical and Photometric Measurements of Mercury Vapor Lamps"—Subcommittee Chairman J. S. Franklin.

(a) Electrical Measurements part approved by entire committee by letter ballot, and submitted to Council.

(b) Photometric Measurements part in preparation by Subcommittee.

(7) "Guide for Life Performance Testing of Fluorescent Lamps"—Subcommittee Chairman Priscilla Presbrey. Revision of 1948 report completed by Subcommittee, submitted to entire committee for approval and to Council.

(8) "Guide on Brightness Measurements" — Subcommittee Chairman P. H. Lamson — in preparation by Subcommittee.

(9) "Guide for Reporting Lighting Equipment Engineering Data" — Subcommittee Chairman E. H. Witte. Revision of 1949 report completed by Subcommittee.

(10) "Guide for the Photometric Testing of Fluorescent Luminaires" — Subcommittee Chairman G. A. Horton. Subcommittee organized to prepare up-to-date revision of 1948 report.

Railway-Mounted Power Plant Demonstrated by Army Engineers

A railway-mounted power plant capable of supplying a city of 20,000 inhabitants with all its electricity was recently demonstrated by the Corps of Engineers at Fort George G. Meade, Maryland. For the next year the 5000-kilowatt plant will be test-operated at Fort Meade, where it is expected that it will produce all the electric power for the entire army installation.

Fort Meade was selected as the test site because the power requirements there compare to those of many civilian communities with a 15 to 20 thousand population which have no heavy industrial plant.

Operation and maintenance of the power unit has been placed in the hands of the 526th Engineer Detachment (Power Plant Operating). Captain Howard O. Knous, Commanding Officer of the power plant detachment thinks that besides its military use this gas-turbine generator has great potential for disaster areas. The two railway cars are provided with interchangeable axles, wheels and brake lugs so that they can be hauled over tracks of various gauges throughout the world.

U. S. Army Signal Photo

Here and There With I.E.S. Members

CHRISTMAS came early to the Michigan Section of I.E.S., when the theme of their first meeting was Christmas in October. The meeting was held in Frankenmuth, Mich., with open house at the Bronner Christmas Display Co. In photo at left are Mr. Bronner with Floyd Sell, retiring Chairman, who was presented with an illustrated memento for his year's service. In photo at right, Edwin Miller; incoming Chairman Edward L. Fairchild; Fred Ready and Earl Domoney discuss the delicious fried chicken dinner, which was held at Zehnder's.

CERTIFICATE of Appreciation from the Section is presented to retiring Iowa Section Chairman R. C. Holcombe (right) by incoming Chairman L. J. Widigen at the Section's Fall Conference in Waterloo, Iowa, October 21. Seated at left is Milton Buzan.

CHARTER NIGHT for the Bluenose Chapter of I.E.S. was held at the Sword and Anchor Hotel, in Halifax, N. S. on November 1. In photo at left, the Chapter's gavel, a gift from the Suwannee River Chapter, is presented to Chairman Henry Lushington (right) by Canadian Regional V-P Joe Thomas. In photo above Ed Landriault, Chairman of the Membership Committee, presents the Sustaining Member Certificate to G. Pottle, on behalf of the Nova Scotia Power Commission. Left to right in the photo are: Harry Cromwell; Ken Wilkinson, Secretary; Joe Thomas, Regional V-P; Ron Dickie, Chairman of the Maritime Chapter; G. Pottle of the Nova Scotia Power Commission; Ed Landriault, Membership Chairman; George Robinson, Vice-Chairman of the Maritime Chapter; and Henry Lushington, Bluenose Chapter Chairman.

T E L E C A S T

LIGHTING NEWS OF CURRENT INTEREST

January 31 Is Deadline For 1956 Conference Paper Outlines

A deadline of January 31, 1956, has been set by the Papers Committee for outlines of proposed papers for the 1956 National Technical Conference. Outlines of proposed papers in triplicate, should be mailed to:

H. F. Davidson
Chairman, I.E.S. Papers Committee
c/o Hydro-Electric Power Commission of Ontario
620 University Avenue
Toronto 2, Ontario, Canada

"Look" Magazine Repeats Adequate Wiring Competition

Following its successful contest last year, Look Magazine is repeating its Adequate Wiring Competition, as an annual industry-wide event for appliance dealers and distributors, utilities and contractors. This year's awards will cover four categories, and will be presented at the 13th annual conference of the National Adequate Wiring Bureau, February 23 and 24 in Chicago.

The categories for awards are:

Merchandising Achievement award for appliance dealers; for successful promotion of adequate wiring in selling to the multi-appliance home.

Community service award for utility companies, for developing consumer acceptance of the need for adequate wiring.

Merchandising achievement award for electrical contractors, for selling adequate wiring to customers needing new wiring or re-wiring in their homes.

Merchandising achievement award for appliance distributors, for promotion of adequate wiring to dealers, contractors and utilities.

Entries should consist of a presentation including such material as tear-sheets of advertisements, pictures of store and outdoor displays, descriptions of TV and radio campaigns, evidence of co-operation with local electrical industry groups, home builders and architects, etc. All entries should be mailed to Look magazine no later than February 1.

I.E.S. member Tom Lynn, lighting specialist for the Southwestern Public Service, Amarillo, Texas, shared in one of the awards in last year's competition. His company and the Connecticut Light and Power Co. shared top honors in the utility category. Other winners in last year's contest were:

W. Ernest Butcher, Butcher Electrical Service, Dallas, Texas.

John M. Newton, Oakes Electrical Supply Co., Holyoke, Mass.

T. H. Bartindale, Cincinnati Gas & Electric Co., which won a special plaque.

McGraw Award Presented At NECA Conference

Don B. Clayton, Sr., president of Electric Constructors, Inc., Birmingham, Ala., received the Contractors Medal and Purse given under the James H. McGraw Award for Electrical Men, at the general meeting of the National Electrical Contractors Association, October 31, at the Waldorf-Astoria, New York City.

Mr. Clayton received the award "for his dedicated personal leadership and industry statesmanship which have brought constructive recognition of the vital role of the electrical contractor in the broad activities of the electrical industry."

At the same time an Honorable Mention was given to Louis Freund, of New York City, for his contributions of effort

OFFICERS of the Ark-La-Tex Chapter, I.E.S., at their installation meeting, October 10, in Shreveport, La. Left to right are: Dan M. Mack, Board of Managers; R. C. Jackson, Secretary-Treasurer; Carl R. Shepherd, Chairman; Clifford D. Ham, Vice-Chairman; and John Bowen, Board of Managers. Not shown in photo is Hal M. Edge, also of the Board of Managers.

and devotion to the development of a sound apprentice training program for the constructive benefit of his industry.

The McGraw Awards consist of a bronze medal and a purse of one hundred dollars.

Design Engineering Show To Be Launched Next May

A Design Engineering Show, described as the first such event has been scheduled for May 14-17, 1956 at Convention Hall in Philadelphia. The announcement has been made by Clapp & Poliak, Inc., who will manage the exposition.

The new show plans to exhibit all types of original equipment which go into the manufacture of a finished product, including parts, components, finishes and basic materials, as well as testing machines, X-ray machines and other equipment with specific design engineering application.

To supplement exhibits, a conference is scheduled at which papers will consider various applications of design engineering theory and practice.

Further information may be obtained from Clapp and Poliak, Inc., 341 Madison Avenue, New York 17, N. Y.

National Electrical Week To Begin February 6

The week of February 6, 1956, was selected as National Electrical Week by representatives of the electrical industry, at a recent meeting of the National Electrical Manufacturers Association. This is Thomas A. Edison's birthday week. Following a proposal made by the International Association of Electrical Inspectors to celebrate this week annually, industry representatives resolved to establish and encourage recognition of the week and bring attention to the contributions of electricity to the well-being of the country.

M. E. Skinner, vice-president of Union Electric Co. of Missouri was elected chairman of the National Electrical Week Committee.

How YOU Can Sell SUSTAINING MEMBERSHIPS

Sustaining Member News

This is the first of a monthly "department" in I.E., to acquaint I.E.S. members with a very vital part of their operation — the Sustaining Membership Committee.

There are many important phases of I.E.S. work, but probably the least understood is, ironically enough, one on which hangs most of the others! — The Sustaining Members Program. The work of I.E.S. has paid off Big, if you want to put it that way, to every phase of the lighting industry — and indirectly, to every member. To be sure the Recommended Practices, Industry Studies and thousands of other tangible achievements of I.E.S. have been produced solely for the "dissemination of lighting knowledge." Such dissemination, however, and in fact, all of the work of the Society, has been a *very very* important factor in the growth of the lighting industry. To spell this out, in dollars and cents value if need be, will be the task this year of every member of the Sustaining Membership Committee, National, Regional, and in the Sections and Chapters. If other members of I.E.S., however, could get a glimpse of (a) the very practical value of I.E.S. work to their industry, and (b) the valuable work still to be done for which funds are lacking — they would all become ex-officio members of the committee and promote its campaign at every opportunity. And to get down to a more personal level, individual member's dues in I.E.S. are the lowest of any comparable Engineering Society in the country. How come? Sustaining Members' dues have kept them low — so far. Whether they can stay that way may well depend on the outcome of the S-M program this year.

Future editions of this department will cover such subjects as Who Should Be Sustaining Members; Why They Should Be Sustaining Members; Future I.E.S. Programs (for which funds are needed) etc. — all for the interest of the membership in general. With a completely new approach to this vital Society program this year, space in this initial item is being devoted to the "opening guns" — the S-M Committee organization, and what they will do. The aid of every member is hereby enlisted — from every Section and Chapter. Volunteer, please, to your Chairman for S-M duty. You may find it the most rewarding I.E.S. work you ever did.

Organization

There are six divisions in the S-M Committee, as of now. Each with its own chairman. And, incidentally, hereafter the list of Sustaining Members published in I.E. will be arranged to show which companies are in what division. Some of these lists may be something of an eye-opener.

(1) Public Utilities. Heading this division will be C. C. Shotwell of Philadelphia Electric — an experienced hand in this work. Chick has done a very creditable job of heading the S-M Committee for the past five years. Among his other achievements in this regard, has been the development of an acceptable formula for public utility S-M dues, based on the number of meters. The S-M Utility Committee will undertake to analyze every State, and every utility (of 50,000 meters or more) in each State. Their job will be to take to each and every one of these companies the down-to-earth facts behind lighting growth and its benefit to them — and the influence of I.E.S. in this growth.

(2) Equipment Manufacturers. Chairman here will be Brooks Chassaing, recently also elected National I.E.S. Director. Brooks is dynamite to whatever he sets his mind to. For example, the last five years he's been active in St. Louis Section of I.E.S., where attendance at monthly meetings has shot up to over 200 average, month in, month out. I.E.S. has a pretty interesting story to tell equipment manufacturers too — and Brooks Chassaing is a good one to tell it. He'll need local help though especially for direct contact with smaller local manufacturers.

(3) Lamp Companies. No Chairman as yet. Most of the lamp manufacturers are already Sustaining Members of I.E.S. — But, the Committee feels, they do not

I.E.S. National Technical Conferences

1956 — September 17-21 — Hotel Statler, Boston, Massachusetts

1957 — September 9-13 — Biltmore Hotel, Atlanta, Georgia

1958 — August 17-22 — Royal York Hotel, Toronto, Ontario

1959 — September 7-11 — San Francisco, California

yet "sow" anywhere near what they "reap" — from the work of I.E.S.

(4) Residential and Portable Lamp Manufacturers. Top portable lamp industry leaders will be in charge of this committee — Frank Marriett of Moe Light, Bill Blitzer of Lightolier, and Morris Thau of Mutual-Sunset. They will have practically a pioneer job to do! The portable lamp field, and residential lighting in general, is a tremendous vital part of the lighting industry. The work of I.E.S., especially through its Residential Lighting Committee, recommended practices and numerous published studies for home lighting technique, has been a big factor. Just how great a factor it is, hasnt been outlined to the industry, heretofore. All that will be different — under the leadership of these three men! Definitely, this field of lighting should participate much much more, in the Sustaining Member Program.

(5) Electrical Wholesalers. George Taylor, one of the most respected and best-liked men in I.E.S. will head this Division. It doesn't take much figuring to determine how beneficial is the work of I.E.S. to electrical distributors and contractors. But it will take a lot of work to reach them all with the facts. George Taylor will need plenty of help for this. Every Section and Chapter will be needed. No mere letter from higher-ups will get the story across to them. It will take a personal canvass of every active wholesaler and contractor in every Chapter.

(6) Related Manufacturers and Miscellaneous Group. This group consists of manufacturers of ballasts, glass, steel, aluminum, plastic, paint, etc.; suppliers for the industry. These people are already aware that the industry's professional Society is very very valuable to them. Hundreds of them came to the recent I.E.S. Convention in Cleveland. So far, no chairman has been appointed to enlist this group in the S-M program. But he will be, soon.

All hands to the pump — from the President to the newest member, and including all officers and the Headquarters staff. That's what is really required to do the job; and in the simplest terms the job is to show present and potential sustaining members why they should support the work of I.E.S. and spell out for them *how much*. It's a selling job, pure and simply. Selling the value of I.E.S. to the people who are reaping the benefits of the Society's work. The President, the officers and the Headquarters staff are already on the team — actively. The purpose of this column will be to enlist every member as well. They certainly stand to benefit from its success. Everybody does!

LIGHTING CALENDAR

Society Events

April 5-7, 1956—Southern Regional Conference, Thomas Jefferson Hotel, Birmingham, Ala.

April 8-10, 1956 — Southwestern Regional Conference, Hilton Hotel, Fort Worth, Texas.

April 12-13, 1956 — South Pacific Coast Regional Conference, Mark Hopkins Hotel, San Francisco, Calif.

April 19-21, 1956 — Pacific Northwest Regional Conference, Davenport Hotel, Spokane, Wash.

April 26-28, 1956—Inter Mountain Regional Conference, Utah Hotel, Salt Lake City, Utah.

May 7-9, 1956—Great Lakes Regional Conference, Commodore Perry Hotel, Toledo, Ohio.

May 10-11, 1956—Midwestern Regional Conference, Severin Hotel, Indianapolis, Indiana.

May 17-18, 1956 — Canadian Regional Conference, Chateau Frontenac, Quebec, Canada.

May 24-25, 1956 — East Central Regional Conference, Shoreham Hotel, Washington, D. C.

September 17-21, 1956 — Illuminating Engineering Society, National Technical Conference, Hotel Statler, Boston, Mass.

Industry Events

January 23-26, 1956—Plant Maintenance & Engineering Show, Convention Hall, Philadelphia, Pa.

January 23-26, 1956—National Rural Electric Cooperative Association (14th Annual Meeting), St. Louis, Missouri.

January 30 - February 3, 1956 — American Institute of Electrical Engineers, Winter General Meeting, Hotel Statler, New York, N. Y.

February 6-9, 1956 — 5th Annual Industrial Ventilation Conference, Michigan State University, Ann Arbor, Mich.

February 23-24, 1956—12th Annual National Adequate Wiring Conference, LaSalle Hotel, Chicago, Ill.

February 26-29, 1956 — National Electric Sign Association, Annual Convention, Jefferson Hotel, St. Louis, Mo.

March 12-16, 1956 — National Electrical Manufacturers Association, Edgewater Beach Hotel, Chicago, Ill.

April 29 - May 4, 1956 — Society of Motion Picture and Television Engineers, Hotel Statler, New York, N. Y.

June 4-7, 1956 — Edison Electric Institute, 24th Annual Convention, Atlantic City, N. J.

Week of June 10, 1956—National Association of Electrical Distributors (48th Annual Convention), Ambassador-Chelsea Hotels, Atlantic City, N. J.

June 25-29, 1956—American Institute of Electrical Engineers, (Summer & Pacific General Meeting), San Francisco, Calif.

June 27-July 5, 1956—International Electro-Technical Committee, Munich area of Southern Germany.

October 1-5, 1956—American Institute of Electrical Engineers (Fall General Meeting), Morrison Hotel, Chicago, Ill.

October 2-4, 1956—Canadian Electrical Manufactureres Association (12th Annual Meeting), Sheraton Brock Hotel, Niagara Falls, Ontario, Canada.

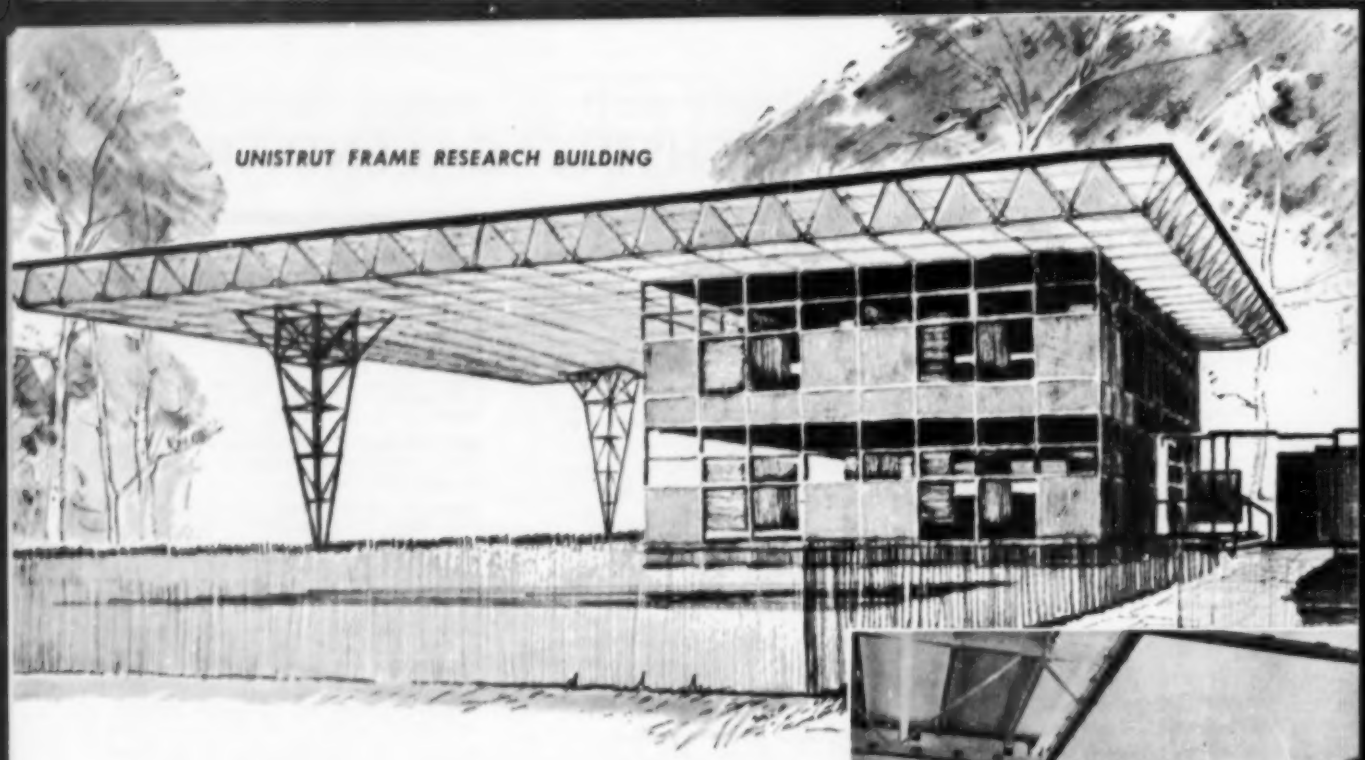
October 7-12, 1956 — Society of Motion Picture and Television Engineers, Ambassador Hotel, Los Angeles, Calif.

October 22-24, 1956 — American Standards Association, 38th Annual Meeting (In conjunction with Seventh National Conference on Standards), Hotel Roosevelt, New York, N. Y.

October 22-26, 1956—National Safety Council, 44th National Safety Congress & Exposition, Chicago, Ill.

November 12-16, 1956—National Electrical Manufacturers Association (Annual Meeting), Traymore Hotel, Atlantic City, N. J.

FIRST Fall meeting of the I.E.S. New England Section, October 17, featured the installation of new officers. Left to right, they are: Carleton M. Holden; Ralph L. Huse; John M. Young presenting gavel to W. B. Elmer, the incoming Chairman; Frank E. Winslow and Walter L. Ball. Officers not shown in the photo are John F. G. Eichorn, Jr., Norman E. Tiedhurst, and Richard W. Wilson.



CEILING IN SPACE FRAME STRUCTURE FEATURES TRANSLUCENT PANELS OF EXTRUDED LUCITE®

Two-story research laboratory at Ann Arbor embodies new concept in design

A STUDENT in the College of Architecture and Design installing a 4' x 4' translucent panel of "Lucite" acrylic resin. The experimental laboratory consists of an enclosed area, 33 by 49 feet beneath a 70- by 90-foot roof. The drafting area on the lower level of the enclosed area uses a ceiling of Du Pont "Lucite" acrylic resin for transmitting optimum light without glare.

"Durable, flexible, expandable, demountable and reusable." That's one professor's description of the new research laboratory at the University of Michigan. The Unistrut Space Frame System introduces a third dimension of reinforcement—diagonal struts to distribute stress in three directions. As a result, supporting columns are needed only at widely spaced intervals and interior walls carry none of the roof load.

The walls, ceiling, and roof utilize many 4' x 4' translucent and transparent panels. For example, on the lower level under the north mezzanine the ceiling is constructed of Du Pont "Lucite" acrylic resin. These lightweight modular units of "Lucite" were extruded by Gering Products, Inc., of Kenilworth, New Jersey. They transmit all wave lengths of visible light, are glare-free. Panels of "Lucite" are exceptionally strong and can withstand direct and prolonged exposure to sunlight and weathering without discoloring or crazing.

"Lucite" permits unusual decorative effects. It comes in a wide variety of transparent and translucent colors. Extruded "Lucite" acrylic resin can be fabricated into troffer-type panels and corrugated shapes to meet any custom design specifications.

For further information on "Lucite" acrylic resin—its properties and uses as a lighting material—write to E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 2812, Du Pont Building, Wilmington 98, Delaware. In Canada: Du Pont Company of Canada Limited, P. O. Box 660, Montreal, Quebec.

Good Lighting Is Good Business

DU PONT

REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

Operation I.E.S.

"Know Your Society" could well be another name for this new department of I.E. Many phases of I.E.S. operation do not normally come to the attention of the membership and these columns, in each issue, will be designed to discuss operations of the Society of interest to all, prepared by the General Secretary.

Since membership in the organization is the starting point for the whole operation, the first column will be devoted to that subject.

Actually, "membership" in any Society measures its success. Sheer numbers of "workers" is its means of achieving its ultimate goal. In I.E.S. our goal is the dissemination of knowledge of illumination. In this we are in the happy position of dispensing a service which deals specifically with human beings, their ability to see, and the comfort in which they perform their work.

I.E.S. is not a large Society, compared with other organizations with engineering interests. See Fig. 1. But we have a membership that is closely knit with a sense of friendliness. An attitude of cooperation — a sort of "family" feeling, that is almost unique to this group alone. For the good of the art or science, we all push together in the same direction, seeing eye to eye in our one objective — to provide adequate, quality illumination for all. Our businesses are varied in different phases of the lighting industry — and it is there, and only there, that our interests are divided.

With so much more attention being given today to the importance of lighting, our Society is bound to increase its membership; perhaps more from some groups than others. Currently our membership is 8279, in which is represented utilities, lamp companies, fixture manufacturers, electrical wholesalers, contractors and others. Quite likely every organization, small or large, social or scientific, seeks membership increases. Their usual method is to ask every member to assume the responsibility of getting one other member. This is a nice gesture and a good idea — but it never seems to materialize.

The I.E.S. Membership Chairman W. A. (Bill) Stannard, is not shooting for the moon in his plans for increasing our membership. He does have a down to earth approach, though, and looks to his committee to carry out some simple but effective campaigning. A look at the past indicates that some of the local membership chairmen do a good job, while others linger along. This year Bill asks for support from every Section and Chapter Chairman, as well as the Membership Committee. He will also make a plea to hold resignations to a record minimum, an important factor in membership growth. The drive this year is for 1,250 new members — and few, if any, delinquent drops. The job can only be done on the local level — with the active help of every member.

In the Membership Competition amongst Sections and Chapters, prizes are divided into two categories. One is for the greatest number of members brought in during the year. The other takes into consideration resignations, with prizes based on the lowest per cent loss during the year. Sections and Chapters will be divided into four groups so that membership increases and decreases will be on a fair competitive basis. Although the monetary value of the prize is worth the winning, the important feature in taking first place will be in the *honor* accruing to the winning Section. The Society regards this activity as one of highest importance.

Sections and Chapters carry out in their own way various activities for the interest and pleasure of their members. They have much to offer. So has the whole Society, nationally. See Fig. 2 for a break-down of these services.

The pie chart (Fig. 2) shows a total of $22.13 worth of service dispensed to each member last year. Individual member dues and entrance fees last year averaged $12.81 per member. How come? How *can* the Society offer $22.13 per member in services? Obviously, to do this income must come from other sources. Among these are dues from Sustaining Members, investments, publication sales and advertising revenue. Within its income, I.E.S. operates on a very tight budget, as might well be surmised. Moreover, its contribution to Basic Research must be given much more consideration, as has been emphasized in the addresses of both Past President Duncan Jones, and President Bob Hartenstein.

In all sincerity, the Society is asking the Membership Committee, and all members, to push this year's drive for members in a big way. The support of everyone is solicited. Suggest names during the year to the Membership Committee. Jot down a few names now and pass them along. The few minutes it takes may bring in a new member. Bill Stannard will love you for it, and the member you may get could be the one to help win a prize in your Section or Chapter — and top honors, too.

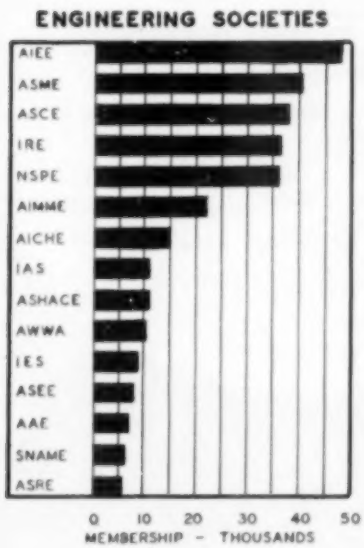


Figure 1.

Figure 2.

ABOUT PEOPLE

The British Illuminating Engineering Society has conferred Honorary Membership upon **H. C. Weston,** in acknowledgment of his services to the Society over many years, and in recognition of his contribution to knowledge of the part good lighting plays in facilitating the activities of daily life.

Walter J. Karash has joined the Duro-Test Corp. as Vice President in charge of engineering. Mr. Karash comes to his new position from the General Electric Co. in Nela Park, where for 21 years he was Chief Engineer respectively in charge of fluorescent manufacturing and equipment, of fluorescent quality and design, and of phosphors.

(Continued on page 12A)

SCHOOL Lighting is discussed by Willard Allphin, Sylvania Electric Products Inc., as guest speaker at the October 20 meeting of the St. Louis Section. Official attendance was 90, among which were School Superintendents and School Board members, some of whom were guests of the Illinois Power Co.

(Continued from page 11A

Kenneth Dunphy, of Canadian General Electric Co., in Toronto, has been transferred to Quebec City by the company. Replacing him as Chairman of the Toronto Section of I.E.S. is **Grant Davidson,** Hydro Electric Power Commission in Toronto.

Kopp Glass, Inc., has announced the addition of **Tyler G. Pett** to its technical staff. He had been associated with Bausch & Lomb Optical Co. as head of the Glass Physics Section of the Chemical Research Laboratory. With Kopp Glass, Mr. Pett will specialize in problems of glass structures in relation to physical and chemical properties.

Appointment of **Fred A. Doelling** as St. Louis, Mo., district manager of the lighting division of Mitchell Manufacturing Co., Chicago, has been announced by that company. The Mitchell St. Louis office is located at Room 308, 705 Olive St.

Pittsburgh Corning Corp. announces the appointment of **Frank D. Kessler** to its Research & Development Division at Port Allegany, Pa. He will assist in research development work pertaining to the company's glass blocks and Foamglas insulation.

Three new sales representatives have been appointed by the Novelty Lighting Corp., manufacturers of interior and exterior incandescent lighting equipment. These are: for the New England States, **Fred Vorlander,** 80 Boylston St., Boston, Mass.; for Alabama, Georgia and Florida, **Robert Kuzell,** 183 Midway Rd., Decatur, Ga.; and for the state of Tennessee, **Collin Finney,** 4048 Outer Drive, Nashville, Tenn.

The R. A. Manning Co., of Sheboygan, Wis., manufacturers of public building lighting equipment have appointed a new representative in the Southern California and Nevada area. This is the C. A. Peterson Co., comprising **C. A. Peterson** and his partner son, **Vic Peterson.** The company has its office at 782 East 14th Place, Los Angeles, Calif.

The appointments of **William J. Donlin, III, Robert W. Eadie,** and **Thomas S. Hemenway Jr.,** as District Representatives for General Electric's Construction Materials Division have been announced. Mr. Donlin will be located in the Allentown, Pa., area where he will handle the Division's Conduit Products, Wiring Devices and Wire and Cable lines. Mr. Eadie, with the company since 1951, will cover the Davenport, Iowa, area. Mr. Hemenway, who has been with General Electric since 1947, has been assigned to the Chicago area.

Otis Zumwalt has been named Director of Purchasing for Thomas Industries Inc., Louisville, Ky., manufacturers of residential lighting fixtures in its Moe Light Division.

M. G. Smith, former executive vice-president of Rockwood & Co., Brooklyn, N. Y., was elected comptroller of the Electric Storage Battery Co., at a meeting of the board of directors November 2.

Deaths

Forester F. Ainsworth, Connecticut Section.

Samuel Perley Goodale, New England Section.

Vincent Kohlroser, Golden Gate Section.

Marshall D. Nutt, New York Section.

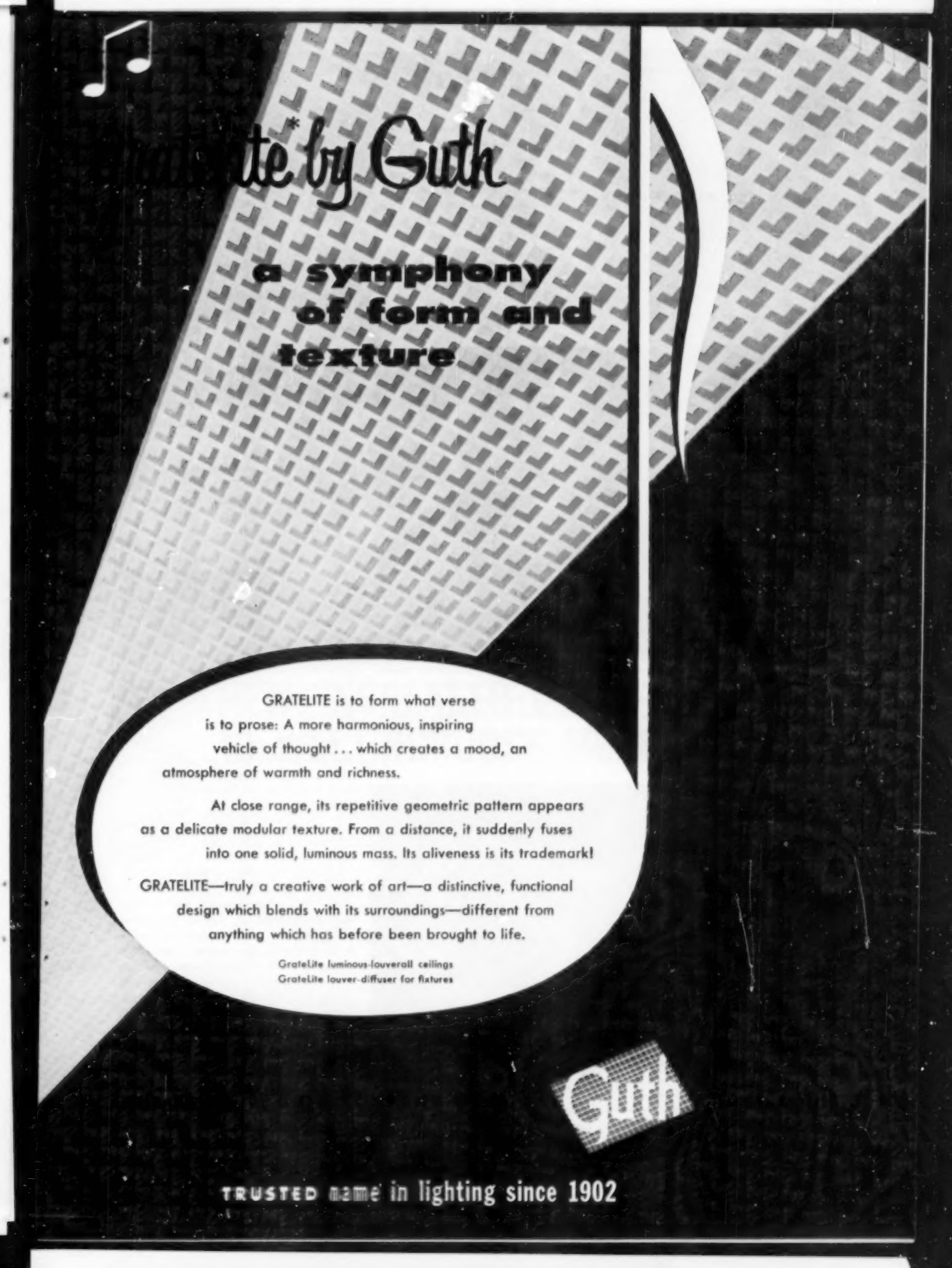
Arthur E. Shildorth, Southern California Section.

H. M. Williams, Toronto Section.

(Continued on page 14A)

1956 Regional Conferences

Region	Place	Date
Southern	Birmingham, Alabama Thomas Jefferson Hotel	April 5-7
Southwestern	Fort Worth, Texas Hilton Hotel	April 8-10
South Pacific Coast	San Francisco, California Mark Hopkins Hotel	April 12-13
Pacific Northwest	Spokane, Washington Davenport Hotel	April 19-21
Inter-Mountain	Salt Lake City, Utah Utah Hotel	April 26-28
Great Lakes	Toledo, Ohio	May 7-8
Midwestern	Indianapolis, Indiana Severin Hotel	May 10-11
Canadian	Quebec, Quebec Chateau Frontenac	May 17-18
East Central	Washington, D. C. Shoreham Hotel	May 24-25


te by Guth
a symphony of form and texture
GRATELITE is to form what verse is to prose: A more harmonious, inspiring vehicle of thought . . . which creates a mood, an atmosphere of warmth and richness.
At close range, its repetitive geometric pattern appears as a delicate modular texture. From a distance, it suddenly fuses into one solid, luminous mass. Its aliveness is its trademark!
GRATELITE—truly a creative work of art—a distinctive, functional design which blends with its surroundings—different from anything which has before been brought to life.
GrateLite luminous-louverall ceilings
GrateLite louver-diffuser for fixtures
Guth
TRUSTED name in lighting since 1902

BOOKS AND PAMPHLETS

*Books whose reviews are marked * are available for inspection at the I.E.S. Headquarters Office, Technical Dept.*

***Light Calculations and Measurements,** by H. A. E. Keitz, published by N. V. Philips' Gloeilampenfabrieken, Eindhoven, Holland, 1955, 413 pages, illustrated and indexed, cloth-bound. $7.50. Available in the United States from Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y., or directly from the publishers in Eindhoven, Holland.

This book is an introduction to the system of quantities and units in light-technology and to photometry. The author, drawing on his twenty years of practical experience in Philips Photometric Laboratories, has written a broadly comprehensive text. This book is one of the "Light and Lighting" series in the Philips' Technical Library.

The first section, on light calculations, deals with a review of the system of dimension and nomenclature. It includes a chapter on the properties of optical systems and also a chapter on reflection, absorption and transmission which gives a very full treatment of this subject, especially on reflection of road surfaces. This is tied in with Chapter XX, in the second section, on measurement of reflection, transmission and absorption.

The second section, on measurement of light, deals extensively with methods of photometry. The appendix includes sections on international cooperation in illuminating engineering, a selection of books on illuminating engineering and photometry, and examples of the light distribution of lighting fittings.

AVIATION Lighting, from the viewpoint of the pilot and the equipment manufacturer, was the topic at the October 18 meeting of the Connecticut Section I.E.S., held at Bradley Field, Windsor Locks, Conn. Left to right, in photo, are: Henry Kelly, Section Chairman; John S. Haney of Crouse-Hinds, speaker; Captain Hugh O. Coleman of United Airlines, speaker; and Robert Chase, Section Program Chairman.

Some of the 50 attending the Connecticut Section meeting. A tour of the modern facilities of the airport followed the speaking part of the program.

Technical Publications: Their Purpose, Preparation and Production, by C. Baker, published by John Wiley & Sons, New York, N. Y., 302 pages, $6.00.

Concerned with scientific occupations, this book outlines methods for presenting and producing technical writing and illustrations. It is directed to the technician who is called upon to convey his ideas as clearly and economically as possible, despite a lack of writing experience.

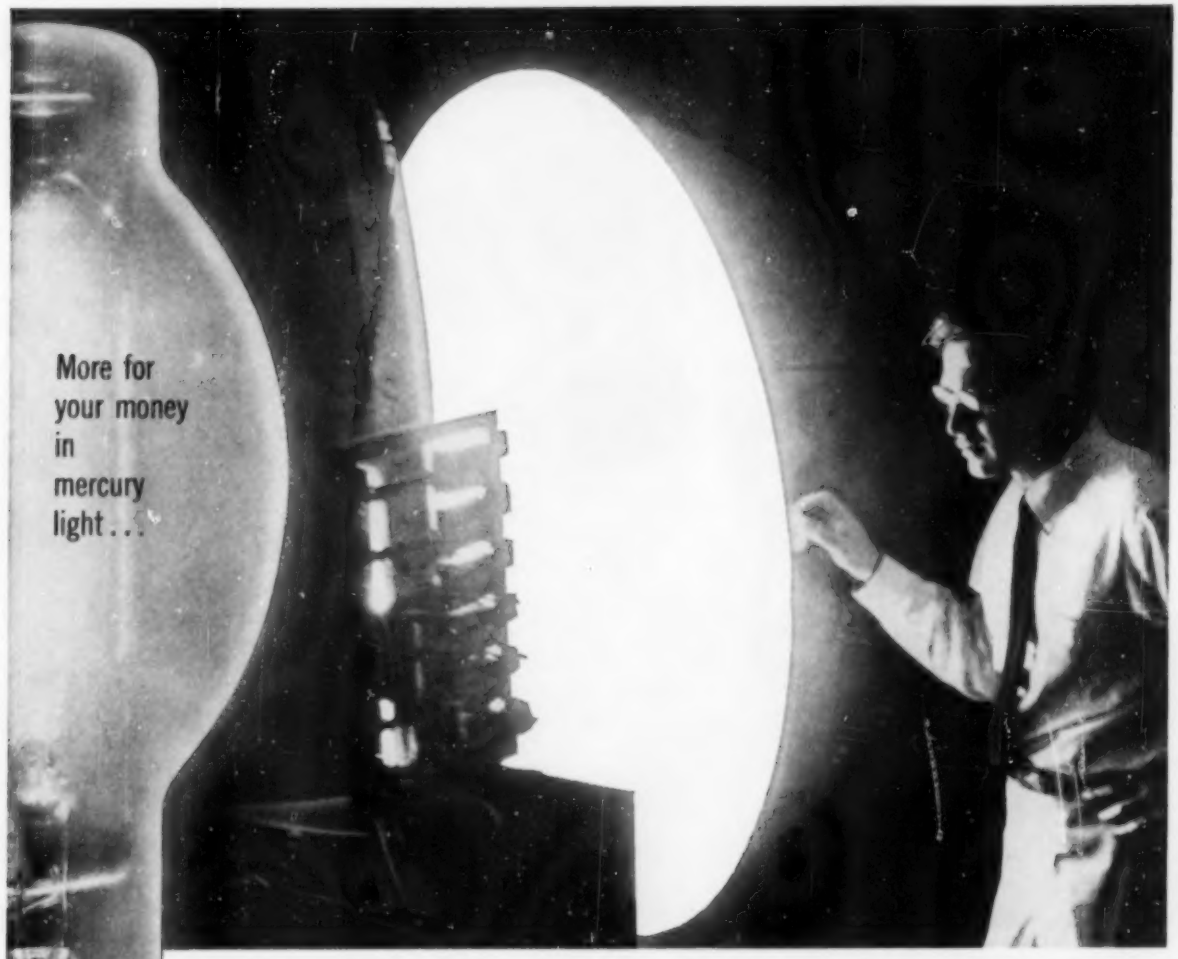
Proceedings of the Street Tree and Utility Conference, published by the Edison Electric Institute, 420 Lexington Ave., New York. $2.40 per single copy, quantity prices upon request.

As described by its title, this book contains the record of the Street Tree and Utility Conference held last March in Cleveland, Ohio. The conference was sponsored by I.E.S., the National Shade Tree Conference and the Edison Electric Institute.

Effects of an Atomic Blast on Electric Power Facilities, published by the Edison Electric Institute, 420 Lexington Ave., New York, N. Y., $0.75.

Cleared by the Atomic Energy Commission and the Federal Civil Defense Administrator, this booklet is a report by the men who carried out last Spring's "Operation Cue" test, in which EEI, representing the electric power industry, joined with other industries and the federal government in finding out what would happen to a community under nuclear attack. Conclusions reached in the report are (1) it appears probable that electric service could be restored to homes in a stricken area before its residents could reoccupy them. Industrial plants probably could get their service as soon as they were ready to resume production. (2) Scope of the repair problem would depend directly on the size of the area affected. (3) Radioactivity, under the conditions of the test, would cause no

(Continued on page 17A)



NEW, INCREASED LIGHT OUTPUT FOR 13 WESTINGHOUSE MERCURY LAMPS

Now—through advanced design and manufacturing techniques—the most widely used Westinghouse Mercury Lamps give you more light when *new*, more light *for life*.

Look at the following chart. It shows the new boost in initial light output for just two of the most widely used Westinghouse Mercury Lamps . . .

Lamp	Initial Lumens	
	Old Rating	New Rating
400-watt E-H1	20,000	21,000
400-watt J-H1	19,000	20,000

And there are similar high increases for *eleven* other popular Westinghouse Mercury Lamps.

But that's only half the story! For not only do these new, improved Westinghouse Mercury Lamps give increased light output to start with, they also *maintain* higher light output throughout their long life. For example . . .

Lamp	Approximate Lumens at 4000 Hours	
	Old	New
400-watt E-H1	15,000	15,600
400-watt J-H1	14,000	14,700

These new Westinghouse Mercury Lamps are absolutely unequalled for *long useful life*. So today, even more than before, Westinghouse Mercury Lamps are by far your best buy for all high-intensity lighting.

This significant advance in Westinghouse Mercury Lamp performance is further evidence of Westinghouse leadership in mercury lighting—one more proof that Westinghouse Mercury Lamps give you "*more for your money in mercury light.*"

Westinghouse Guarantees the service life of all its widely used types of quartz mercury lamps. For full details call your Westinghouse Lamp Representative—or write Westinghouse Lamp Div., Dept. IE-2, Bloomfield, N. J.

TYPICAL MONEY-SAVING FEATURES OF WESTINGHOUSE MERCURY LAMPS...

Bi-Temp life-time-tight bases—non deteriorating bonding material eliminates costly problems of loose bases, cracked bulbs, breakage when lamps are removed from sockets.

Molybdenum Ribbon Seals—just .005" thick—permit easy expansion and contraction of lead-in wires and bulb material. Result: longer lamp life, fewer early failures.

YOU CAN BE SURE...IF IT'S Westinghouse

Ask about new Westinghouse WEATHER DUTY(TM) Mercury Lamps!

INSTALLATION: Sun Oil Company District Accounting Office, Dayton, Ohio

PROJECT ENGINEER: Alex M. Engart

ELECTRICAL CONTRACTOR: Helldoerfer-Castellini, Dayton, Ohio

FIXTURES: Litecontrol #5524, 2 lamp slimline recessed troffers, using Holophane low brightness lenses, #9033 and #9034

CEILING HEIGHT: 10' 0"

SPACING: 8' 0"

FINISHES: Walls, light green — Ceiling, light gray — Floors, light to medium — Desk Tops, medium gray

INTENSITIES: 40 Footcandles in service (intensity figures courtesy Lighting Sales Dept., Dayton Power & Light Co., Dayton, Ohio)

Sun Oil gets More "Mileage" in Lighting – by LITECONTROL

Sun Oil won't have to change its lighting fixtures every 1000 "miles"! This installation uses the very popular Litecontrol #5524 lens which not only does an excellent job *now* but permits the addition of fixtures in the future to make continuous rows, if desired. Note the neat fit of the fixtures in the ceiling and the smartly modern but business-like appearance.

This installation is a repeat performance by Litecontrol for Sun Oil — this time in their new office. It pays to stick with a good brand particularly when experienced counsel in lighting is so helpful and handy. For good light for better vision at standard fixture costs . . . consult *your* Litecontrol Representative.

LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

(Continued from page 14A)

particular repair problems. If an area were inhabitable at all, maintenance crews could enter and make repairs.

Two identical electric transmission and distribution systems were used in the test, one built at 4700 feet from the point of explosion and the other at 10,500 feet.

The New Life, 35 mm, 12-minute slide film with 33⅓ rpm narration recording, produced by and available from Miss Edythe Polster, 148 E. 48th St., New York, N. Y. Unit price, $100, discounts on extra prints and records.

This 55-picture strip film has been produced to help utilities promote adequate residential wiring. It is designed for showing to consumer audiences to promote home modernization in wiring. A series of cartoons with narration on record, it shows the mishaps occurring when the home owner tries the "do it yourself" method of repairing wiring.

Soviet Professional Manpower, by Nicholas De Witt, published by the National Science Foundation in cooperation with the National Academy of Sciences, National Research Council, Washington, D. C. Available from the Superintendent of Documents, $1.25.

The result of a two-year study of the Soviet educational system and of the supply and distribution of its professional manpower, this book is published with the hope that it will focus attention on the capabilities of other nations in science and also arouse interest, particularly at the local level, in the need for greater attention to our own problems in identifying and training persons with special aptitudes for careers in science and technology.

The objectives and methods of educational systems in the Soviet Union and the United States are compared, and some statistical data on availability of scientific manpower is cited.

NEW MEMBERS

At the meeting of the I.E.S. Council Executive Committee held at New York, N. Y. on November 16, 1955, the following were elected to membership. Names marked * are transfers from Associate Member grade.

ALABAMA CHAPTER

Associate Member:
Bates, G. A., Alabama Power Co., Montgomery, Ala.

ARIZONA SECTION

Associate Member:
Carbiener, Homer, Arizona Public Service Co., Phoenix, Ariz.

SPEAKERS at the I.E.S. New York Section's and Residence Lighting Forum's joint meeting, October 13, were Laurence Harrison, consulting engineer, and Miss Eve Freyer of Westinghouse Lamp Division's Residence Lighting Department. Mr. Harrison spoke on Museum Lighting, and Miss Freyer's topic was Lighting Pictures and Decorative Objects in the Home.

BLUENOSE CHAPTER

Associate Member:
Russell, H. B., H. B. Russell & Co., Ltd., Halifax, N. S.

BRITISH COLUMBIA SECTION

Member:
*Gray, W. J., B. C. Electric Railway Co., Vancouver, B. C.

CAPITAL SECTION

Associate Members:
Connor, B. K., Potomac Electric Power Co., Washington, D. C.
Gill, C. C., National Capital Parks, Washington, D. C.

CENTRAL ILLINOIS CHAPTER

Member:
Jerome, B. A., 413 W. Wilcox, Peoria, Ill.
Associate Members:
Feldkamp, G. H., Crescent Electric Supply Co., Peoria, Ill.
Wofford, B. M., Sylvania Electric Products Inc., St. Louis, Mo.
Yocum, M. L., Crescent Electric Supply Co., Peoria, Ill.

CENTRAL NEW YORK SECTION

Associate Member:
Colson J. M., Jr., General Electric Co., Syracuse, N. Y.

CHICAGO SECTION

Associate Members:
Chapin, G. K., General Electric Co., Chicago, Ill.
Dupuis, H. L., Schmidt, Garden &Erikson, Chicago, Ill.
Engel, F. L., Engel Advertising Inc., Chicago, Ill.
Friedberg, J. F., Lithonia Lighting Products Co., Chicago, Ill.
Hamilton, J. C., Advance Transformer Co., Chicago, Ill.
Kagey, D. F., Union Metal Mfg. Co., Chicago, Ill.
Koppen, L. W., Public Service Co., Division of Commonwealth Edison Co., Glencoe, Ill.
Krause, W. H., Benjamin Electric Mfg. Co., Des Plaines, Ill.
Leech, J. E., Solar Light Mfg. Co., Chicago, Ill.
Luebke, G. E., Benjamin Electric Mfg. Co., Des Plaines, Ill.
Pape, J. A., Commonwealth Edison Co., Chicago, Ill.
Schulz, C. L., Alkco Mfg. Co., Chicago, Ill.

CLEVELAND SECTION

Associate Members:
Henderson, Robert, General Electric Co., Cleveland, Ohio.
Hornickel, J. C., General Electric Co., Youngstown, Ohio.
Paul, J. A., Ohio Power Co., Canton, Ohio.

CORNHUSKER CHAPTER

Member:
*Donelson, D. L., 2927 N. 58th St., Omaha, Nebr.
Associate Members:
Dergan, H. G., City of Omaha, Omaha, Nebr.
Trenerry, J. A., Leo A. Daly Co., Omaha, Nebr.

FLORIDA SECTION

Associate Members:
Britt, D. R., Bigby Electric Co. Inc., Tampa, Fla.
Torres, A. P., Graybar Electric Co., Tampa, Fla.
Williams, I. A., Graybar Electric Co., Tampa, Fla.

FOREIGN NON SECTION

Associate Member:
Quek, Choon, S. T. Quek Furniture Store, Quek Electric & Plumbing Service, Singapore, 7.

GEORGIA SECTION

Member:
Brown, E. A., General Electric Co., Atlanta, Ga.

GOLDEN GATE SECTION

Associate Members:
Cook, R. E., Jr., North State Electric Supply Co., San Francisco, Calif.
Fontaine, L. R., Pacific Gas & Electric Co., San Francisco, Calif.
Student Members:
Narumit, Sirichai, University of California, Berkeley, Calif.
Tipton, Richard, University of California, Berkeley, Calif.

INLAND EMPIRE CHAPTER

Associate Members:
Carlson, A. V., Washington Water Power Co., Spokane, Wash.
Nelson, M. I., Jensen Byrd Co., Spokane, Wash.
Parock, W. M., General Engineers, Missoula, Mont.

IOWA SECTION

Associate Members:
Schlader, D. R., Crescent Electric Supply Co., Dubuque, Ia.
Schwartz, B. W., General Electric Co., Cedar Rapids, Ia.

MARYLAND SECTION

Associate Member:
Taylor, D. W., Westinghouse Electric Supply Co., Baltimore, Md.

MEXICO CHAPTER

Associate Member:
Barrios, Daniel, Comision Federal de Electricidad, Mexico, D. F.

(Continued on page 35A)

COMMITTEES

COMMITTEES 1955-1956

All committees are appointed by the President, subject to approval of the Council and, except as provided in the Constitution, terminate at the time of the first Council Meeting each administration, in the month of October. The scope of each committee is indicated.

R. F. Hartenstein, President, ex-officio member of all committees.

STANDING COMMITTEES

BOARD OF FELLOWS — To evaluate the eligibility of candidates for transfer to grade of Fellow according to procedures approved by the Council.

W. V. C. Foulks, Chairman, Curtis Lighting, Inc., 6135 W. 65th St., Chicago 38, Ill.

R. M. Evans — R. M. Love
S. G. Hibben — Roy A. Palmer
George E. Shoemaker

COUNCIL EXECUTIVE — To conduct the affairs of the Society between Council meetings.

R. F. Hartenstein, Chairman, Ohio Edison Company, Akron 8, Ohio.

K. M. Reid — G. J. Taylor
J. S. Schuchert — M. N. Waterman

FINANCE — To have direct supervision of the financial affairs of the Society and to present to the Council an annual report on its financial condition. To make recommendations to the Council as to the investment of moneys and upon all specific appropriations. To prepare and submit for approval of Council not later than the October meeting a budget of income and expense for the ensuing fiscal year.

W. W. Booth, Chairman, General Electric Supply Corp., 1260 Boston Ave., Bridgeport 8, Conn.

C. C. Keller — J. S. Schuchert, ex-officio
W. P. Lowell, Jr. — R. M. Zabel

GENERAL BOARD OF EXAMINERS — To investigate the qualifications of all applicants for admission to membership; to elect or reject applicants for the grade of Associate Member and Student Member, to report such action to the Council; and to make recommendation to the Council regarding applications for transfer or election to the grade of Member and for transfer to the grade of Member Emeritus.

Svend W. Bruun, Chairman, Rambusch Decorating Co., 40 W. 13th St., New York 11, N. Y.

H. E. D'Andrade — Ralph MacVean

MEDAL AWARD — To evaluate the eligibility of candidates for award of the I.E.S. Medal according to procedures approved by the Council.

Ward Harrison, Chairman, 23475 Stanford Road, Cleveland 22, Ohio.

Berlon Cooper — D. M. Jones
G. F. Dean — A. H. Manwaring
C. H. Goddard — E. M. Strong
B. J. Jensen — L. E. Taylor

PAPERS — To procure, review and approve all technical papers and discussions thereof, for presentation before National Conferences of the Society.

H. F. Davidson, Chairman, Hydro-Electric Power Commission of Ontario, 620 University Ave., Toronto, Ont., Canada.

L. E. Barbrow — E. F. Lowry
B. S. Benson, Jr. — Floyd W. Sell
L. J. Buttolph — G. A. Trosper
B. F. Greene — H. L. Wright
R. M. Zabel

PUBLICATIONS — To be responsible for the procurement, review and approval of all material for the publications of the Society other than technical papers approved by the Papers Committee for presentation at National Conferences of the Society and their discussions and committee reports, for which it will have publication responsibility only. Shall also be responsible for the editing, printing and business management of the publications of the Society; specific exceptions may be made by Council.

J. S. Schuchert, Chairman, Duquesne Light Co., 435 Sixth Ave., Pittsburgh 19, Pa.

Brooks Chassaing — Aileen Page
H. F. Davidson — John Ronayne
J. A. Schneller

Regional and Section and Chapter Representatives to be named.

Subcommittee on Changes and Improvements

John Ronayne, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

Subcommittee on Editorial Content

H. F. Davidson, Chairman, Hydro-Electric Power Commission of Ontario, 620 University Ave., Toronto, Ont., Canada.

L. E. Barbrow — E. F. Lowry
B. S. Benson, Jr. — Floyd W. Sell
L. J. Buttolph — G. A. Trosper
B. F. Greene — H. L. Wright
R. M. Zabel

Subcommittee on Publication Sales

Brooks Chassaing, Chairman, Art Metal Company, 911 Locust St., St. Louis 1, Missouri.

and Section and Chapter Representatives.

Subcommittee on Technical Data Sheets

J. A. Schneller, Chairman, Lighting Products, Inc., 1549 Park Ave., W. Highland Park, Ill.

and Section and Chapter Representatives.

Subcommittee on Home Lighting Data Sheets

Aileen Page, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

GENERAL COMMITTEES

ADVANCE PLANNING — To study the operation, program, publication activities, membership classifications and financial structure with a view of its immediate and long-range objectives and to make recommendations to Council.

F. C. Winkler, Chairman, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland 1, Ohio.

G. W. Beals — Glenn E. Parks
A. H. Clarke — E. M. Strong
B. J. Jensen — L. C. Twichell
W. P. Lowell, Jr. — J. F. Whitehead, Jr.
R. M. Zabel

ADVISORY BOARD TO THE PRESIDENT — To examine the organization, accomplishments, and assignments of committees and prepare not later than July 1st of each year a proposed list of committees and personnel; and to evaluate costs and benefits of present and proposed Society services.

M. N. Waterman, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

G. W. Beals — D. M. Jones
C. L. Crouch — K. M. Reid
A. D. Hinckley — F. C. Winkler

ALLIED ARTS — To encourage and assist local competitions in allied arts, in cooperation with technical committees and interested local groups.

Karl A. Staley, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

C. A. Atherton — Kenneth Parsons
Douglas H. Baker — R. C. Putnam
Robert W. Brown — Frank G. Reed
T. J. Killian — W. D. Riddle
Onnie Mankki — Laurence Schmeckebier
Joseph McCullough — G. E. Shoemaker
Eldon Winkler

BOARD OF NOMINATION — To prepare a nomination ticket containing the names of those who are deemed best suited to serve as officers and directors in positions to be filled at the ensuing election

E. M. Strong, Chairman, Cornell University, Ithaca, N. Y.

D. M. Jones — A. H. Manwaring
and Regional Representatives.

CONSTITUTION AND BY-LAWS — To prepare for Council proposed amendments to the Constitution.

G. F. Dean, Chairman, Toronto Hydro-Electric System, 14 Carlton St., Toronto, Ont., Canada.

Arvid S. Almryde — R. G. Slauer
J. B. Browder — Walter Sturrock

COORDINATING COMMITTEE FOR DEFENSE — To contact various Government Agencies concerned with National Security suggesting cooperation and participation in specific projects as an aid to solution of their problems. Recommending the placement of lighting study projects in present committees or the appointment of study project committees to the Society President and to expedite such study projects and guide accepted reports into proper Government channels.

A. F. Wakefield, Co-Chairman, The Wakefield Company, Vermilion, Ohio.

J. W. Bateman, Co-Chairman, Canadian General Electric Co., Toronto, Ont.

H. R. Blackwell — C. L. Crouch
R. B. Brown, Jr. — K. M. Reid
O. P. Cleaver — John S. Walsh
M. N. Waterman

HISTORICAL — To assemble and make available for current reference and to prepare in suitable and durable form for posterity, such historical facts, printed memorabilia, photographs, voice records, museum specimens and allied items as may be judged worthy of composing a continuing digest of the record of the Society's history.

S. G. Hibben, Chairman, 31 Clinton Avenue, Montclair, New Jersey.

R. B. Burton, Sr. — C. A. B. Halvorson
Julius Daniels — H. L. Logan
Leo Dolkart — J. L. Stair
G. H. Stickney

LIGHTING SERVICE — To stimulate and promote the discussion and practical application of lighting recommendations and to conduct a

(Continued on page 21A)

Architects: Johnson, Hatch and Wulff.
Electrical Engineer: J. S. Hamel.

For permanence . . . quality beauty . . . PLEXIGLAS

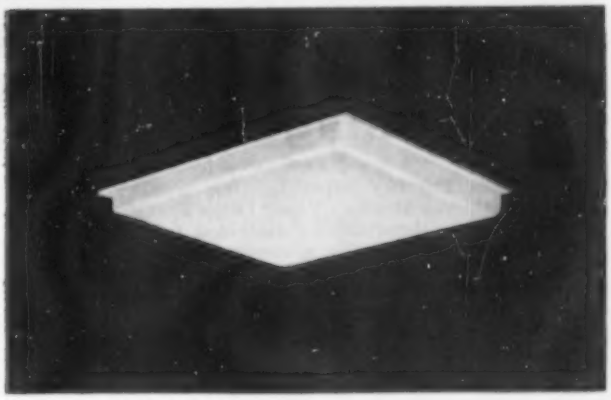
Throughout the reading areas of the new San Diego Public Library, fluorescent fixtures with large formed diffusers of PLEXIGLAS provide low-brightness, high-level lighting.

Here are the reasons for the constantly increasing use of PLEXIGLAS acrylic plastic in lighting:

PLEXIGLAS provides superior transmission and diffusion of light. It is rigid, strong and durable, with exceptional freedom from discoloration on long exposure to fluorescent lamps. In outdoor lighting, it provides time-proved resistance to weather.

Lighting engineers and architects specify PLEXIGLAS for diffusers on large-area indoor and outdoor fixtures, and for luminous ceilings, when they want the permanence, strength and beauty that add up to illumination of the highest quality.

PLEXIGLAS is a trade-mark Reg. U.S. Pat. Off. and in principal foreign countries.



Chemicals for Industry

ROHM & HAAS COMPANY

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries.

Canadian distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay at Jarvis Street, Toronto, Ontario, Canada.*

Rohm & Haas Company
Washington Square, Philadelphia 5, Pa.

Please send me: ☐ "Architectural Lighting with PLEXIGLAS".
☐ "Outdoor Lighting with PLEXIGLAS".

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Firm _____

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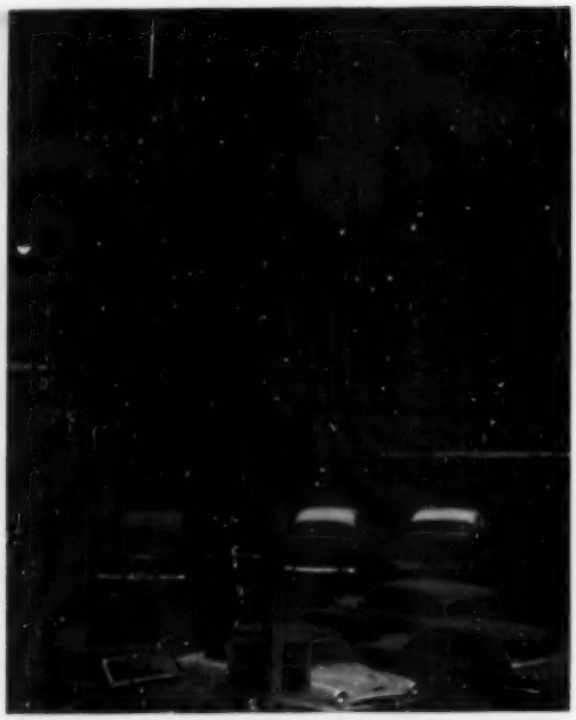
(PS-20)

LINE VOLTAGE DROPS TO 80V ON SOLA CONSTANT-WATTAGE BALLASTED INSTALLATION: *"Outages" are prevented due to the patented constant wattage circuit in Sola Mercury Vapor Lamp Transformers. Even when line voltage drops as low as about 75v on a 115v line, lamps stay lit, eliminating the need for "auxiliary" incandescent or fluorescent lighting installations.*



LINE VOLTAGE DROPS TO 80V ON CONVENTIONALLY-BALLASTED INSTALLATION: *Line voltage drops often cause outages. Until lamps return to strikeable condition, vital minutes of production time may be lost in industrial installations; safety hazards may exist in parking lots (as shown above) or playgrounds or plant area protection applications.*

Sola Constant Wattage Transformers For E-H1 400w Mercury Vapor Lamps End Outages Due to Line Voltage Drops

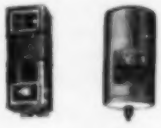
When your mercury vapor lighting installation is ballasted with Sola Mercury Vapor Lamp Transformers, you can rely on dependably-maintained light output. First, outages are virtually eliminated since primary voltage must drop below about 75v on a 115v line before lamps extinguish. Second, the Sola Patented Constant Wattage Principle assures lumen regulation within $\pm 2\frac{1}{2}\%$, even in the face of line voltage variations as great as $\pm 13\%$.

In addition, Sola Constant Wattage Mercury Vapor Lamp Transformers offer the following advantages over conventional ballasts:

- Eliminate the need for primary taps . . . positive starting within the primary ranges of 100 to 130 and 200 to 260 volts.
- Low starting current surge . . . line current during starting interval limited to effectively no more than normal full load value.
- Open and short-circuit protection . . . primary current positively limited under abnormal operating conditions of lamp failure, or external short circuit . . . constant wattage circuit eliminates any lamp electrode rectification.
- Extended lamp life . . . regulated voltage, current, and wattage permit continuous, stable operation, resulting in superior lamp life.
- Low crest factor . . . (peak/rms ratio) of lamp current averages only 1.7 at 115v primary supply.

It will pay you to investigate the advantages of Sola-ballasted mercury vapor lighting installations for both indoor and outdoor high intensity lighting applications. Request your Sola representative to call.

SOLA *Mercury Vapor Lamp* **TRANSFORMERS**



Write on your letterhead for Bulletin 3L-MV-219.

CONSTANT VOLTAGE TRANSFORMERS for Regulation of Electronic and Electrical Equipment • **LIGHTING TRANSFORMERS** for All Types of Fluorescent and Mercury Vapor Lamps. • **SOLA ELECTRIC CO.**, 4633 West 16th Street, Chicago 50, Illinois. Bishop 2-1414 • *NEW YORK 35:* 103 E. 125th St., TRafalgar 6-6464 • *PHILADELPHIA:* Commercial Trust Bldg., Rittenhouse 6-4988 • *BOSTON:* 272 Centre Street, Newton 58, Mass., Bigelow 4-3354 • *CLEVELAND 15:* 1836 Euclid Ave., PRospect 1-6400 • *KANSAS CITY 2, MO.:* 406 W. 34th St., Jefferson 4382 • *LOS ANGELES 23:* 3130 E. Olympic Blvd., ANgelus 9-9431 • *TORONTO 9, ONTARIO:* 617 Runnymede Rd., RO 7-1654 • Representatives in Other Principal Cities

(Continued from page 18A)

Lighting Service Forum in connection with the National Technical Conference.

L. E. Taylor, Chairman, The Detroit Edison Co., 2000 Second Ave., Detroit 26, Michigan.

MEMBERSHIP — To develop plans and supervise the operation of the individual membership activity of the Society.

W. A. Stannard, Chairman, Consumers Power Co., 212 W. Michigan Ave., Jackson, Mich.

Fred Arady	W. J. Montabone
Francis Clarke	G. L. Morris
J. S. Frizzell	Charles Selby

and Section and Chapter Representatives

NATIONAL TECHNICAL CONFERENCE — To be completely responsible, subject to the approval of Council, for the general coordination of all conference activities, for selecting and recommending time and place for review of the plans and budgets of the National Technical Conference Executive Committee and in cooperation with the Papers Committee for the satisfactory time allocation for the Technical Papers sessions according to Procedures and Policies as adopted by Council.

J. C. Forbes, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

C. L. Amick	A. D. Hinckley
W. W. Booth	C. N. Laupp
J. B. Browder	C. W. McCormick
R. B. Brown, Jr.	J. D. Mitchell
H. F. Davidson	John Ruffatto
Clare K. Fulton	L. E. Tayler

Joseph Thomas

1956 Conference Executive Committee

R. B. Brown, Jr., Chairman, Boston Edison Co., 39 Boylston St., Boston 12, Mass.

R. G. Slauer	R. F. Townsend
N. E. Ticehurst	F. J. Vorlander

R. W. Wilson

PROCEDURES AND POLICIES—To study problems of Society procedure and policy referred to the Committee by Council, and to formulate recommendations to Council for the statement, revision, or clarification of these procedures and policies consistent with the Constitution and By-Laws of the Society.

G. W. Beals, Chairman, The Miller Co., Meriden, Conn.

Brooks Chassaing	W. A. Stannard
G. F. Dean	L. C. Twichell
C. C. Shotwell	J. S. Walsh

F. C. Winkler

PUBLIC RELATIONS AND INFORMATION — To prepare and disseminate information about the activities, accomplishments, programs, objectives and policies of the Society and about the place of illuminating engineering in modern society; to formulate and submit public relations policies and plans for the Society.

J. F. Whitehead, Jr., Chairman, Day-Brite Lighting Inc., 5411 Bulwer Ave., St. Louis 7, Mo.

W. L. Byrne	F. E. Guth
A. H. Clarke	S. H. Hazleton
B. C. Cooper	R. M. Johannesen
W. A. Dalrymple	W. A. Stannard

and Section and Chapter Representatives

REGIONAL ACTIVITIES — To represent the respective Regions before the Council and to keep the Council informed regarding the affairs of the Regions. To stimulate Society activities, to encourage joint meetings of Sections and Chapters including Regional Conferences within the respective Regions and to promote the expansion of the Society.

K. M. Reid, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

James R. Chambers	Blair E. Plowman
John G. Felton, Jr.	A. C. Sangster
Dan M. Finch	Joseph Thomas
C. W. McCormick	Nelson C. Warner
J. Dixon Mitchell	J. D. Whitnell

Southern Region, Assistant to Regional Vice-President, George L. Morris.

RESIDENCE LIGHTING FORUMS — To stimulate and assist the Residence Lighting Forums of the Society and to encourage the formation of additional Forums. To conduct a Residence Lighting Forum in connection with the National Technical Conference.

Ruth Morris, Chairman, Georgia Power Company, P. O. Box 1719, Atlanta, 1, Georgia.

Lillian Eddy	Buford Martin
Eve Freyer	Elizabeth Parker
Katharine Goodall	Jan Reynolds
Evelyn Hansen	Harry E. Robbins
Robert J. Lee	Virginia Skinner

SUSTAINING MEMBERSHIP—To develop plans and supervise the operation of the Sustaining Membership activity in the Society according to the Procedures and Policies adopted by Council.

Fred E. Guth, Chairman, The Edwin F. Guth Co., 2615 Washington Ave., St. Louis 3, Mo.

Brooks Chassaing	C. C. Shotwell
	G. J. Taylor

and Section and Chapter Representatives

TRUSTEES, I.E.S. HEADQUARTERS RETIREMENT PENSION PLAN

A. H. Manwaring, Chairman, Philadelphia Electrical & Mfg. Co., 1228 N. 31st St., Philadelphia 21, Pa.

W. W. Booth	D. M. Jones
	J. S. Schuchert

TASK COMMITTEES

GOLDEN ANNIVERSARY

R. G. Slauer, Chairman, Sylvania Electric Products Inc., Salem, Mass.

HEADQUARTERS PLANNING — To study and recommend to Council plans for Headquarters location and space requirements both short-range (1955 — approx. 1959) and long-range (approx. 1960-1970), taking into account prospective needs of Headquarters personnel.

George J. Taylor, Chairman, Day-Brite Lighting Inc., 161 E. 42nd St., New York 17, N. Y.

C. C. Keller	K. M. Reid
	M. N. Waterman

I.E.S.-U. S. PUBLIC HEALTH SERVICE — To outline a method of making a survey of the visual factors of the working environment and the workers' vision and evaluating the findings in terms of visual comfort and effectiveness and eye health.

J. F. Parsons, Chairman, Niagara Mohawk Power Corp., Electric Bldg., Buffalo 3, N. Y.

B. S. Benson, Jr.	Henry N. Doyle
Mrs. Tulla Brocard	Neal Jacobus
L. J. Cahill	A. L. Koven
George Clayton	R. P. Teele

TASK COMMITTEE ON SOCIETY DUES

D. M. Jones, Chairman, Curtis Lighting of Canada., Montreal, Que.

TECHNICAL COMMITTEES

AVIATION — To study the application of light and lighting to the spaces and functions involved in the operation of aircraft.

D. C. Miller, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

H. J. C. Pearson, Vice-Chairman, 1619 Sunken Road, Fredericksburg, W. Va.

P. H. Greenlee, Secretary, Grimes Mfg. Co., Urbana, Ohio.

J. F. Angier	A. L. Lewis
F. C. Ashe	R. E. Madigar
F. B. Brady	A. L. Morse
F. C. Breckenridge	W. A. Pennow
H. A. Cramer	T. H. Projector
R. E. Dahlin	L. C. Simpson
C. A. Douglas	R. G. Slauer
I. F. Fagin	R. J. Stephany
W. C. Fisher	L. C. Vipond
G. M. Kevern	Martin Warskow
M. K. Laufer	A. B. Winters

CIVIL DEFENSE — To appraise and report on special lighting problems connected with emergency military operations that directly involve civilian defense and protection, such as equipment for bomb shelters, special street and vehicular lighting, mobile self-contained lighting facilities for use in bombed areas, and emergency lighting devices and visual aids to movement in the event of power failure.

J. C. Forbes, Co-Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

J. W. Bateman, Co-Chairman, Canadian General Electric Co, Ltd., 165 Dufferin St., Toronto, Ont., Canada.

J. S. Walsh, Secretary, Pacific Gas & Electric Co., 245 Market St., San Francisco., Calif.

COLOR & ILLUMINATION — To study, evaluate and report on the effect of color in relation to the art and science of illumination.

R. C. Allison, Chairman, T. Eaton Co., 190 Yonge St., Toronto, Ont., Canada.

W. C. Granville, Vice-Chairman, Container Corp. of America, 38 S. Dearborn St., Chicago, Ill.

DAYLIGHTING — To study the problems involved in daylighting, develop recommended practices and report thereon.

H. B. Vincent, Chairman, Owens-Illinois Glass Co., 1700 N. Westwood Ave., Toledo, Ohio.

W. J. Arner	W. F. Little
L. E. Barbrow	W. O. Lytle
G. F. Bauer	T. H. MacDonald
R. L. Biesele, Jr.	H. E. Machamer
R. A. Boyd	Murray McDavitt
A. A. Brainerd	R. W. McKinley
H. S. Bull	G. Meyer
W. W. Caudill	E. C. Miles
E. W. Conover	R. A. Miller
Doyt Early	Parry Moon
W. B. Ewing	S. W. Quisenberry
W. E. Folsom	W. C. Randall
C. D. Gibson	R. H. Reed
B. F. Greene	F. K. Sampson
J. W. Griffith	Paul W. Seagers
J. S. Herbert	D. E. Spencer
G. N. Hingston	Andrew Vogel
H. F. Kingsbury	K. C. Welch
F. L. Knowles	O. F. Wenzler
E. M. Linforth	C. J. Youngblood

Availability of Daylighting (Exterior)

B. F. Greene, Chairman, 100 W. 42nd St., New York, N. Y.

R. A. Boyd	J. W. Griffith
	H. F. Kingsbury

Coordinating

R. A. Boyd, Chairman, University of Michigan, Research Engineering Institute, Ann Arbor, Mich.

R. W. McKinley	R. A. Miller
	D. E. Spencer

Brightness Ratio Measurements

W. J. Arner, Chairman, Libbey-Owens-Ford Glass Co., 1701 E. Broadway, Toledo 5, Ohio.

E. W. Conover	Murray McDavitt
J. W. Griffith	E. C. Miles

Lower Ceiling Classrooms

H. F. Kingsbury, Chairman, Pittsburgh-Corning Corp., Research Dept., Port Allegany, Pa.

C. J. Allen	Raymond Vance Hall
J. W. Griffith	C. A. Winkelhake

Measurement and Reporting of Daylight

J. W. Griffith, Chairman, Southern Methodist Univ., Dept. of Engineering Research, Dallas, Texas.

J. S. Herbert	R. H. Reed
E. M. Linforth	D. E. Spencer

FARM LIGHTING — To study the application of light and lighting of farm buildings, surrounding work areas and other rural locations and to report thereon.

O. C. Lange, Chairman, Pennsylvania Power & Light Co., 9th & Hamilton Sts., Allentown, Pa.

Erwin Baker	L. E. Innis
T. M. Barr	Arthur Kramer
J. P. Ditchman	Howard Long
O. D. Hunt	Joseph Schaenzer
M. Fahsbender	A. J. VonBurg

(Continued on page 23A)

First Security Bank of Utah, Salt Lake City

For low maintenance costs... install Day-Brite lighting

This First Security Bank installation shows how Day-Brite troffers and Mobilex® fixtures combine unusually attractive office-building lighting with low maintenance costs. Enclosing elements of these modern units have separable hinges—they can be instantly opened from either side, or completely removed, for fast, easy servicing. Enclosures reduce dirt accumulation, fixtures stay cleaner longer. Maintenance and servicing costs are kept at a minimum.

Both Mobilex and troffer units are adaptable for mounting in six different ceiling types. This provides unusual flexibility in meeting any lighting requirement.

SEE, EXAMINE and COMPARE Day-Brite with any other lighting units. Look at the fixtures, not just the pictures. Ask your Day-Brite representative to show you.

The inviting effect of Day-Brite Mobilex units is illustrated in this section of the main banking floor.

Note the uniform lighting on desk-top areas afforded by Day-Brite troffers in this typical office area.

Day-Brite Lighting, Inc.

5432 Bulwer Ave.
St. Louis 7, Missouri

5486

DECIDEDLY BETTER
DAY-BRITE
Lighting Fixtures

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL LIGHTING EQUIPMENT

(Continued from page 21A)

IES-ASHAE (Am. Soc. Heatg. & Aircond. Engrs.) JOINT COMMITTEE — To study the relationship between lighting and various factors that enter into the thermal environment and report thereon.

Walter Sturrock, Chairman, General Electric Co., Nela Park, Cleveland 12, Ohio.

R. W. McKinley — E. H. Salter

ASHAE Cooling Load Subcommittee

John Everetts, Jr. — A. T. Jorn
J. N. Livermore

ILLUMINATION PERFORMANCE RECOMMENDATIONS — To prepare illumination performance recommendations for luminaires conforming to CIE classifications, excluding residential.

B. S. Benson, Jr., Chairman, Benjamin Electric Mfg. Co., Des Plaines, Ill.

R. D. Burnham — W. H. Kahler
G. W. Clark — E. H. Salter
Kurt Franck — R. P. Teele
William Weibel

INDUSTRIAL — To initiate, follow up and coordinate lighting study projects in the industrial field, review the reports of the various subcommittees in this field and make recommendations to Council.

W. P. Lowell, Jr., Chairman, Sylvania Electric Products, Inc., 60 Boston St., Salem, Mass.

A. A. Brainerd — C. C. Keller
J. R. Chambers — Norman Kridel
W. H. Kahler — E. A. Linsday
Howard Long

Central Station Properties

L. G. Parks, Chairman, Ebasco Services Inc., 2 Rector St., New York, N. Y.

A. A. Brainerd — J. E. Kaufman
R. S. Bucher — E. A. Linsday
H. F. Carroll — Howard Long
H. A. Cook — D. J. O'Neill
R. W. Corwin — C. B. Stephens
D. W. Taylor

Clothing Industry

Norman Kridel, Chairman, Rochester Gas and Electric Co., 89 East Ave., Rochester, N. Y.

L. Gauthier — B. A. Thomas
W. E. Hayes — L. C. Twichell
Carl Uthe

Foundries

E. A. Linsday, Chairman, General Electric Co., Nela Park, Cleveland, Ohio.

C. W. Briggs — W. H. Johnson
W. M. Caldwell — J. H. Lansing
F. E. Mueller

Graphic Arts — Printing Industry

Ralph Enghouser, Chairman, Sylvania Electric Products, Inc., 1938 Lincoln Liberty Bldg., Philadelphia, Pa.

Michael Flynn — John Mucha
William N. Harrison — Warren B. Reese
Percy Holmes — Robert E. Rossell
J. Wallace Scott

Sub-Subcommittee on Color Appraisal

Philip E. Tobias, Co-Chairman, Edward Stern & Co., Philadelphia, Pa.

Norman Macbeth, Co-Chairman, Macbeth Corp., Newburgh, N. Y.

Fred Bahls — E. A. Linsday
P. R. Holmes — W. B. Reese
G. W. Youngjove

Outdoor Productive Areas

R. H. Goodman, Chairman, Crouse-Hinds Co., Syracuse, N. Y.

W. R. Davies — W. R. Preece
J. W. Lee — A. G. Voelkner
D. J. O'Neill — W. W. Weld
Elden H. Witte

Sawmills

James Barnes, Chairman, Pacific Gas & Electric Co., North Bay Division, P.O. Box 540, San Rafael, Calif.

D. M. Finch — D. King
Emanuel Fritz — Norman Schiewe
Jerry Howard — P. S. Schmidt
John Keyes — K. B. Stoddard

INSTITUTIONAL — To initiate, follow up and coordinate lighting study projects in the field of public buildings and private institutions, review the reports of the various study subcommittees in this field and make recommendations to Council.

James H. McCulloch, Chairman, Independent Testing Laboratories, 862 19th St., Boulder, Colo.

Joel Rubin — George Shoemaker
C. I. Sayles — W. H. Smith
Carl Zerzen

Auditoriums and Churches

George Shoemaker, Chairman, Philadelphia Electric Co., 1000 Chestnut St., Philadelphia 5, Pa.

Anthony L. Bleecker — T. Norman Mansell
Henrik W. Olsen

Advisors:

Dr. C. Harry Atkinson — Mr. A. H. Fink
Rev. Thomas Burke — Rev. R. S. McCarroll
Mr. L. B. Wadsworth

Hospitals

William H. Smith, Chairman, 20 South Senate, Indianapolis, Ind.

H. W. Alexander — E. H. Greppin
Joseph C. Bonk — N. L. Griffin
B. C. Cooper — Howard Haynes
R. E. Crockett — H. L. Logan
E. R. Domoney — Paul W. Seagers
Harry Gratten, Jr. — E. C. Swenson

Hotels

C. I. Sayles, Chairman, Cornell University, School of Hotel Administration, Ithaca, N. Y.

C. L. Cottrell — J. Fassett
H. E. D'Andrade — Francis Keally
Myrtle Fahsbender — F. B. Mills

Kitchens

Carl Zerzen, Chairman, Chicago Lighting Institute, 37 So. Wabash Ave., Chicago, Ill.

George Gilleard — E. L. Riego
L. V. James — M. W. Ross
C. T. Masterson — Lawrence A. Witt
William Richards — Edward J. Wolff

Theaters

Joel Rubin, Chairman, Kliegl Bros., Inc., 320 W. 50th St., New York, N. Y.

Jules C. Berinstein — G. T. Howard
Alfred Boylen — H. D. Sellman
T. W. Butler — George Smedberg
Theodore Fuchs — Daniel Staehle, Jr.
Rollo G. Williams

LIGHT CONTROL AND EQUIPMENT DESIGN — Collect and correlate the knowledge and data on means and methods of controlling, directing, reflecting, transmitting and diffusing light and on the principles and practices of equipment design.

Joint Subcom.—IES-SPI-NEMA (Plastics)

F. C. Winkler, Chairman, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland, Ohio. W. C. Goggins, Vice-Chairman, The Dow Chemical Co., Midland, Mich.

W. M. Bagley
R. D. Bradley — Carl O. Massopust
J. S. Cappo — R. R. Moyer
A. J. Dragonette — F. W. Ogden
W. F. Fitzgerald — C. Rackley
G. Gilleard — E. H. Salter
Carl Holch — E. Szanty
W. P. Lowell, Jr. — G. P. Wakefield
H. A. Williams

LIGHT SOURCES — To correlate and report available information as to the physics of light and light production and the characteristics of current light sources.

E. H. Salter, Chairman, Electrical Testing Labs., Inc., 2 East End Ave. & 79th St., New York, N. Y.

Charles Amick — George Freeman
Herbert Anderson — B. F. Greene
L. E. Barbrow — E. F. Lowry
W. P. Carpenter — W. W. Lozier
H. F. Davidson — E. H. Raddin

Color Rendition

Dorothy Nickerson, Chairman, 2039 New Hampshire Ave. N. W., Washington 9, D. C.

LIGHTING DESIGN PRACTICE — To study published data on coefficients of utilization, room indexes, maintenance coefficients and other elements entering into calculations for lighting design; develop standard methods for use in Society publications and report thereon.

B. S. Benson, Jr., Chairman, Benjamin Electric Mfg. Co., Des Plaines, Ill.

G. W. Clark — Norman Kridel
Ward Harrison — J. J. Neidhart
Neal Jacobus — W. M. Potter
J. Roy Jones — G. G. Rae
J. O. Kraehenbuehl — E. H. Salter

LIGHTING EDUCATION — To prepare educational and training programs on the fundamentals of illumination, lighting design problems and advance theories of light and lighting application. To prepare required text material and to further their adoption locally.

H. H. Magdsick, Chairman, 15925 VanAken Blvd., Cleveland, Ohio.

R. S. Wiseman, Vice-Chairman, c/o Engineer Research & Development Laboratories, Fort Belvoir, Va.

Abraham Abramowitz — D. M. Finch
W. H. Billhartz — W. A. Hedrich
L. H. Brown — J. O. Kraehenbuehl
Robert Burnham — R. W. McKinley
O. P. Cleaver — R. C. Putnam
A. A. Eastman — F. M. Strong
W. V. C. Foulks — L. E. Tayler
I. A. Yost

Demand for Professionally Trained Illuminating Engineers

W. V. C. Foulks, Chairman, Curtis Lighting Inc., 6135 W. 65th St., Chicago 38, Ill.

O. P. Cleaver — E. M. Strong
R. W. McKinley — L. E. Tayler
I. A. Yost

Curriculum

E. M. Strong, Chairman, College of Engineering, Cornell University, Ithaca, N. Y.

Abraham Abramowitz — J. O. Kraehenbuehl
L. H. Brown — R. C. Putnam
W. A. Hedrich — R. S. Wiseman

Revision of "Experiments with Light"

A. A. Eastman, Chairman, General Electric Co., Nela Park, Cleveland, Ohio.

W. H. Billhartz — R. D. Burnham

Preparation of Brochure "Careers in Illuminating Engineering"

R. S. Wiseman, Chairman, c/o Engineer Research & Development Laboratories, Fort Belvoir, Va.

D. M. Finch — R. W. McKinley
E. M. Strong

LIGHTING MAINTENANCE — To study the elements contributing to maintenance factors; set up the framework of typical field studies to determine factors; and to stimulate the prosecution of such studies by appropriate agencies.

R. L. Zahour, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

F. Clark, Vice-Chairman, Lighting Services, 515 Meridan Rd., Waterbury, Conn.

M. E. Keck, Secretary, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland, Ohio.

R. D. Bradley — C. M. Holden
A. A. Brainerd — Howard Long
R. D. Burnham — D. R. Phillips
L. M. Endres — R. P. Teele
R. R. Enghouser — I. E. Zastrow

(Continued on page 24A)

(Continued from page 23A)

MOTOR VEHICLE LIGHTING (EXTERIOR) — To study the problems of illuminating the night operations of motor vehicles and to make suitable recommendations for promoting maximum safety and convenience including accessory illuminated signal and traffic aids.

R. P. Teele, Chairman, National Bureau of Standards, Washington 25, D. C.

L. L. Beits	William Groth (Capt.)
L. W. Chubb, Jr.	Burton Marsh
W. E. Carpenter	Charles Marsh
Elliot F. Daniels	G. L. McCain
Hedley F. Davidson	Edmund Ricker
Neil Dormstadter	Val J. Roper
R. N. Falge	A. Rugo
D. M. Finch	W. E. Schwanhausser

NOMENCLATURE — To define the terms and standards of illumination, and endeavor to obtain uniformity in nomenclature.

Priscilla Preshrey, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

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E. Q. Adams	H. P. Gage
L. E. Barbrow	S. K. Guth
Robert Bromberg	J. O. Kraehenbuehl
George Clark	W. F. Little
C. L. Cottrell	W. W. Menke

Harris Reinhardt

OFFICE — To study the lighting requirements of office lighting tasks, develop suitable lighting recommendations and report thereon.

J. J. Neidhart, Chairman, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland, Ohio.

G. F. Dean, Vice-Chairman, Toronto Hydro-Electric System, 14 Carlton St., Toronto, Ont., Canada.

A. S. Almryde	G. G. Rae
C. T. Bakeman	T. H. Shepherd
L. M. Endres	O. J. Taylor
W. S. Fisher	Roger T. Waite
W. E. Folsom	G. P. Wakefield
C. W. Macy	R. R. Wylie
R. W. McKinley	R. L. Zahour

PROGRESS — To keep in touch with developments in the art of lighting throughout the world and prepare a yearly review of achievements in the art of illuminating engineering for inclusion in ILLUMINATING ENGINEERING.

PUBLIC CONVEYANCES — INTERIOR LIGHTING — To study the application of light to all public areas in conveyances used for passenger transportation, including particularly trains, buses, ships, street railways and subways, and report thereon.

C. E. Egeler, Chairman, 3014 Berkshire Rd., Cleveland, Ohio.

A. L. Arenberg	F. T. Snider
E. Boghosian	J. B. Spillane
J. C. de la Rosa	J. L. Swarner
J. B. Feder	R. L. Sweeney
E. B. Hallman	R. M. Timmins
R. L. Henderson	A. Vandevelde
T. S. Mandonia	W. C. Wheeler

Interior Lighting — Land Transportation

J. L. Swarner, Chairman, Pullman Standard Car Mfg. Co., 10909 Cottage Grove Ave., Chicago, Ill.

A. L. Arenberg	C. B. Mackay
J. S. Bauer	T. S. Madonia
R. H. Bertsche	W. R. Preece, Jr.
W. N. Bodkin	G. L. Sealey
J. C. de la Rosa	F. T. Snider
E. B. Hallman	W. C. Wheeler
R. L. Henderson	A. C. Zagotta

Marine Transportation

R. Timmins, Chairman, Gibbs and Cox., Inc., 21 West St., New York, N. Y.

W. M. Adrian	E. A. Geary
E. Boghosian	R. K. Johnson
Frank Carlson	T. S. Madonia
J. B. Feder	R. L. Sweeney

A. F. Vandevelde

RESIDENCE — To study and report on the application of light and lighting in residences; to develop performance recommendations for residence luminaires and to prepare necessary educational aids.

Frank J. Marriett, Chairman, Thomas Industries, Inc., 410 S. Third St., Louisville 2, Ky.

William Blitzer	Kaye Leighton
Mary E. Dodds	Elizabeth A. Meehan
Myrtle Fahsbender	Priscilla Preshrey
E. W. Halteman	Jan Reynolds
Arthur R. Jaeger	Mary B. Taepke
C. C. Keller	Morris Thau

Norman Vacha

Outline for Training Program

Mary Taepke, Chairman, Detroit Edison Co., 2000 Second Ave., Detroit, Mich.

Mary Dodds	Evelyn Hansen
Marguerite Fenner	Elizabeth Meehan
Eve Freyer	Frances E. Rosier
Katharine T. Goodall	Virginia Skinner

Norman Vacha

Portable Lamps—Measurement of Performance Characteristics

E. W. Halteman, Chairman, Pennsylvania Power & Light Co., 534 Main St., Bethlehem, Pa.

Arthur Jaeger	Priscilla Preshrey
Kaye Leighton	Jan Reynolds

Revision of "Contemporary Lighting for Modern & Traditional Interiors"

M. Fahsbender, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

Kaye Leighton	Gladys Miller

Jan Reynolds

SCHOOL — To study the application of light and lighting to the spaces and processes involved in educational institutions and to report thereon.

J. M. Chorlton, Chairman, Board of Education, 155 College St., Toronto, Ont., Canada.

C. J. Allen, Secretary, General Electric Co., Nela Park, Cleveland, Ohio.

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R. D. Bradley	C. N. Laupp
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Brooks Chassaing	J. D. MacConnell
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W. V. C. Foulks	Foster Sampson
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D. B. Harmon	E. M. Strong
R. C. Haltgren	H. A. Stroud
L. V. James	John Walsh

K. C. Welch

SEARCHLIGHT — To study the design and application of searchlights and to report thereon.

J. A. Barteit, Chairman, Dept. of Navy, Bureau of Aeronautics, Washington 25, D. C.

Thomas Cushing, Secretary, Hanovia Chemical & Mfg. Co., 100 Barr Bldg., Washington, D. C.

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Pierre Demoureuille	J. Kirk Newell
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R. E. Faucett	C. H. Orr
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George Gerung	Don Petersen
B. Goldberg	B. Pritchard
D. S. Gustin	T. H. Projector
Arthur Hatch	S. Resnick
Charles A. Hearn	H. C. Smith

J. E. Wesler

SIGNAL LIGHTING, ELEMENTS OF — To compile a compendium of current information on all phases of signal lighting.

F. C. Breckenridge, Chairman, National Bureau of Standards, Washington, D. C.

J. A. Barteit	V. J. Roper
H. R. Blackwell	L. C. Simpson
G. M. Kevern	R. T. Tousey
H. J. C. Pearson	M. A. Warskow

SPORTS AND RECREATIONAL AREA LIGHTING — To develop current recommended practices for lighting sports and recreational areas; study techniques of application including effects on player performance and spectator visibility and report thereon.

STANDARDS OF QUALITY AND QUANTITY FOR INTERIOR ILLUMINATION — To prepare standards for illumination levels, brightness limits, brightness ratios for interiors, including specific visual tasks, as well as the general surroundings.

Glenn A. Fry, Chairman, Ohio State University, School of Optometry, Columbus, Ohio.

Willard Allphin	S. K. Guth
L. E. Barbrow	H. L. Logan
H. R. Blackwell	D. E. Spencer
Dean Farnsworth	E. M. Strong

STORE LIGHTING — To study the application of light and lighting to the spaces and processes involved in the selling of goods and to report thereon.

C. M. Cutler, Chairman, General Electric Co., Nela Park, Cleveland, Ohio.

J. J. Neidhart, Vice-Chairman, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland, Ohio.

R. C. Allison	Richard Kelly
D. P. Caverly	G. G. Rae
L. H. Dikelman	Nathan J. Sonnenfeld
Lester Geis	Kenneth Welch

Service Station & Parking Areas

E. H. Schaefer, Chairman, Wisconsin Electric Power Co., 231 W. Michigan St., Milwaukee 3, Wis.

B. S. Benson, Jr.	W. B. Kennedy
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R. H. Goodman	C. T. McGavin
A. L. Hart	R. W. Wagner
M. E. Haskins	E. J. Willits

A. B. Winters

STREET AND HIGHWAY LIGHTING — To establish the scientific principles underlying street and highway lighting; to collect data on the results of the application of such principles to actual practice; to prepare such reports thereon as will assist technicians and benefit the public.

G. K. Glass, Chairman, Detroit Edison Co., 2000 Second Ave., Detroit, Mich.

TECHNICAL COMMITTEE FORUM — To coordinate procedures of our technical committees and to sponsor a lighting application symposium at the National Technical Conference.

M. N. Waterman, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

W. C. Brown	H. P. Steele
W. P. Lowell, Jr.	B. G. Tremaine, Jr.
Kirk M. Reid	A. F. Wakefield

I. A. Yost

TELEVISION—LIGHTING FOR PRODUCTION — To study and report on the lighting for production of television programs.

Walter O'Meara, Chairman, National Broadcasting Co., 30 Rockefeller Plaza, New York City.

Sal Bonsignor	S. McCandless
Reid Davis	K. Palius
G. J. DeStephano	K. Reichenbach
D. W. Frick	C. H. Singer
George Gill	W. R. Wilson
H. A. Kliegl	R. L. Zahour

Lighting Practices

Reid Davis, Chairman, National Broadcasting Co., 30 Rockefeller Plaza, New York, N. Y.

S. Bonsignor	K. Palius

K. Reichenbach

Light Sources

W. R. Wilson, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

W. O'Meara

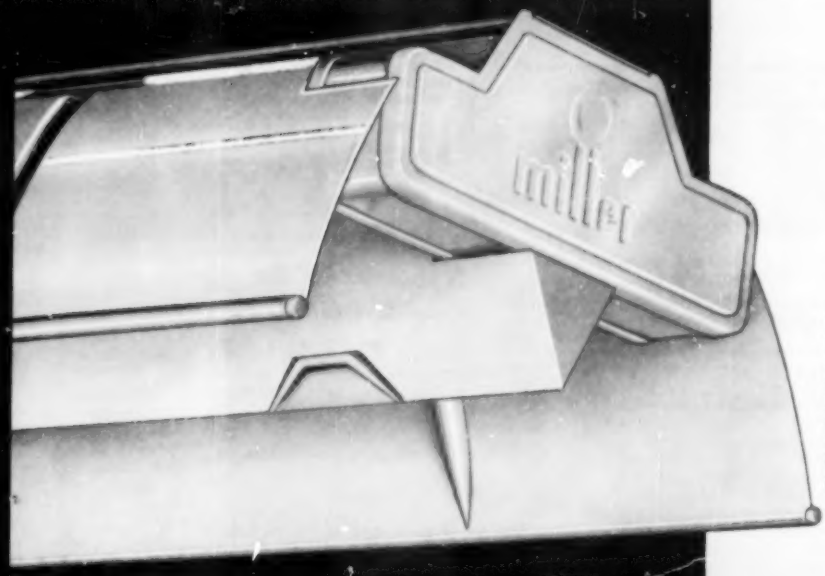
Lighting Equipment Performance Ratings

W. O'Meara, Chairman, National Broadcasting Co., 30 Rockefeller Plaza, New York, N. Y.

S. Bonsignor	S. McCandless

K. Palius

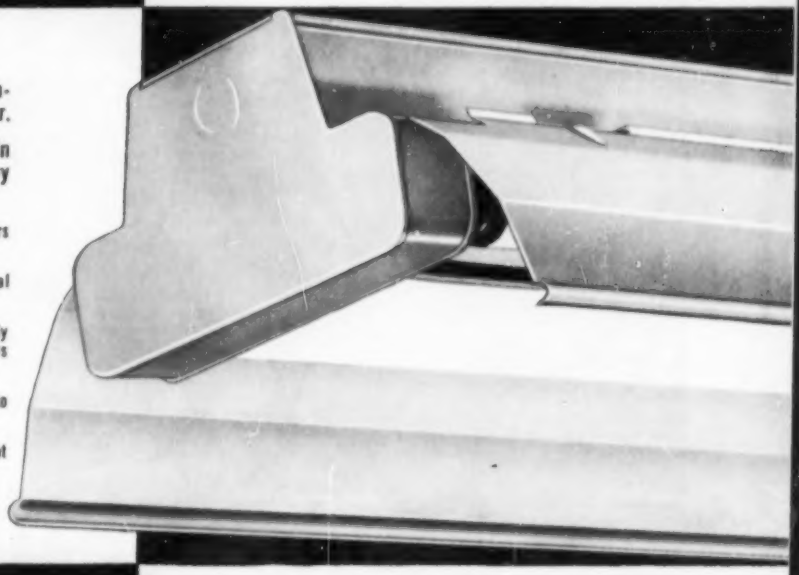
(Continued on page 26A)



NEW MILLER INDUSTRIALS MEET OR EXCEED NEW RLM SPECIFICATIONS

Charted below are 12 of the most important advances in the history of industrial lighting: the new RLM specifications for fluorescent industrial lighting fixtures. The new Miller "Industrials" meet or exceed these specifications in every instance! And that's not all! Many other "extra quality" features make this one of the finest industrial fixtures ever produced —good reason why it always pays to specify MILLER!

- 4 foot reflectors on 8 foot channels for one man maintenance—easy cleaning and changing of reflector.
- Super-rigid reflector and V-channel are stamped in one piece—with sealed rolled bead flanges and heavy reinforcing ribs, lifetime porcelain enamel.
- Extra-sized wiring channel designed for sliding clamp hangers or surface mounting.
- Miller Socket Box construction for easy, economical individual socket replacement.
- Heavy gauge pressure connector provides fast and easy assembly in continuous rows with positive electrical grounding. No screws to align.
- Extra large man-sized captive nuts for mounting reflectors to channel. No tools required.
- Special reflector aligner keeps uniform row alignment—seals light leakage between reflectors.



New RLM Specifications for:	DIRECT	SEMI-DIRECT
1. ALL-WHITE PORCELAIN ENAMEL REFLECTORS (Inside and Outside)	Yes	Yes
2. INCREASED UPWARD LIGHT	5%-15%	20%-30%
3. MAXIMUM BRIGHTNESS	Yes	Yes
4. BETTER SHIELDING ANGLES	13°-14°	27°
5. HIGHER REFLECTION FACTORS	85%	85%
6. HIGHER LIGHT OUTPUT	83%	77%
7. CAPTIVE LATCHING and HOLDING DEVICE	Yes	Yes
8. GROUNDED BALLAST MOUNTING	Yes	Yes
9. CHANNEL DESIGNED for SLIDING HANGERS	Yes	Yes
10. REVISED LAMP SPACING	5"	
11. IMPROVED LAMPHOLDERS	Yes	Yes
12. ENTIRE UNIT RUST-PROOFED	Yes	Yes

RLM STANDARDS INSTITUTE *INCORPORATED*

4' and 8' for 40w Rapid Start Lamps
4' and 8' for 48" and 96" Slimline Lamps
4' and 8' for 48" and 96" High Output Rapid Start Lamps

miller
SINCE 1844

THE MILLER COMPANY
GENERAL OFFICES: MERIDEN, CONN.
FACTORIES: UTICA, OHIO—MERIDEN, CONN.
CURTIS LIGHTING OF CANADA LTD., TORONTO

(Continued from page 24A)

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H. A. Kliegl, IES TV Committee.

H. M. Gurin, SMPTE TV Committee.

J. Rubin, IES Stage Ltg. Committee.

R. L. Zahour, AIEE Committee on Lighting Applications.

TESTING PROCEDURES FOR ILLUMINATION CHARACTERISTICS—To prepare standard test procedures for illumination characteristics of light sources, lighting equipment and illumination materials, and to report thereon.

A. E. Krawcek, Chairman, Crouse-Hinds Co., Syracuse, N. Y.

Phelps Meaker, Vice-Chairman, General Electric Co., Nela Park, Cleveland, Ohio.

J. E. Bock	John Losh
R. D. Bradley	James McCulloch
B. C. Feldman	F. M. Neal
Kurt Franck	Priscilla Presbrey
J. S. Franklin	D. W. Rowten
D. M. Finch	E. H. Salter
W. G. Hill	Floyd Sell
G. A. Horton	R. P. Teele
Paul Lamson	Maxwell Trostle
Dr. Leberknight	A. W. Weeks
T. H. Leister	E. H. Witte

Guide for Life Performance Testing of Fluorescent Lamps

Priscilla Presbrey, Chairman, Westinghouse Electric Corp., Bloomfield, N. J.

B. C. Feldman	E. H. Salter
Wallace G. Hill	George Spears
E. M. Kooker	A. W. Weeks

Guide for Photometric Testing of Fluorescent Luminaires

G. A. Horton, Chairman, Westinghouse Electric Corp., 1216 W. 58th St., Cleveland, Ohio.

R. D. Bradley	W. M. Potter
P. H. Lamson	E. H. Salter
J. A. Losh	Ruland Smith
F. M. Neal	Maxwell Trostle

Elden H. Witte

Guide for Photometric Testing of Fluorescent Lamps

A. W. Weeks, Chairman, Champion Lamp Works, 330 Lynnway, Lynn, Mass.

B. C. Feldman E. H. Salter

Photoelectric Portable Photometers—(Revision of 1937 Report)

G. A. Horton

Guide for Photometric Testing of Outdoor Fluorescent Luminaires

J. S. Franklin, Chairman, General Electric Co., 920 Western Ave., West Lynn, Mass.

J. E. Bock G. A. Horton

T. H. Leister

Guide for Photometry of Searchlights

A. E. Krawcek, Chairman, Crouse-Hinds Co., Syracuse, N. Y.

J. E. Bock J. S. Franklin

Guide for Electrical and Photometric Measurement of Mercury Vapor Lamps

J. S. Franklin, Chairman, General Electric Co., 920 Western Ave., West Lynn, Mass.

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F. M. Neal	E. H. Salter
J. H. Park	A. W. Weeks

J. W. Young

Practical Guide to Photometry

Phelps Meaker, Chairman, General Electric Co., Nela Park, Cleveland, Ohio.

J. S. Franklin	G. A. Horton
Wallace G. Hill	T. H. Leister

A. W. Weeks

Guide for Reporting Lighting Equipment Engineering Data

Elden Witte, Chairman, Benjamin Elec. Mfg. Co., Des Plaines, Ill.

R. D. Burnham	J. H. McCulloch
J. A. Losh	J. F. Parsons

R. P. Teele

Practical Guide for Brightness Measurements

Paul H. Lamson, Chairman, Smithcraft Lighting Div., Chelsea 50, Mass.

R. D. Bradley	J. A. Losh
G. A. Horton	J. H. McCulloch
A. E. Krawcek	Elden H. Witte

OFFICIAL REPRESENTATIVES TO OTHER ORGANIZATIONS

AMERICAN STANDARDS ASSOCIATION SECTIONAL COMMITTEES

(C. L. Crouch, Technical Director, alternate representative to all.)

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B. F. Greene

American Standard Practice for Industrial Lighting, A11

(To be appointed)

American Standard Practice for School Lighting, A23

John Chorlton

Building Code Requirements for Light and Ventilation, A53

B. F. Greene

National Electrical Code, C1

G. E. Shoemaker, Panel 2, 3 & 10

Definitions of Electrical Terms, C42

Priscilla Presbrey

Dimensional and Operational Standardization of Electric Lamps and Auxiliaries for Gaseous Discharge Lamps, C78

Thomas S. Kelly

Inspection Requirements for Motor Vehicles, D7.1

R. P. Teele

Standard for Motion Pictures, PH22; Sectional Committee PH3, Photographic Sensitometry

(To be appointed)

Office Standards, X3
Subcommittee 1—Office Equipment (furniture)
Subcommittee 2—Office Papers
Subcommittee 3—Business Machines

(To be appointed)

Letter Symbols and Abbreviations for Science and Engineering, Y10

Priscilla Presbrey

Drawing and Drafting Room Practice, Y14

Priscilla Presbrey

Graphical Symbols and Abbreviations for Use on Drawings, Y32

Priscilla Presbrey

Preferred Numbers, Z17

J. R. Jones

Standardization in the Field of Photography, Z38

(To be appointed)

Safety Color Code, Z53

W. H. Kahler

Colors for Industrial Apparatus Equipment, Z54

(To be appointed)

Standardization of Optics, Z58

Priscilla Presbrey

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C. L. Crouch

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A. C. Brodahl G. E. Shoemaker

Publication of New Handbook on Wiring for Small Commercial Occupancies

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(To be appointed)

INTER-SOCIETY COLOR COUNCIL

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R. P. Teele

Subcommittee on Vehicle Lighting

R. P. Teele
V. J. Roper, Alternate

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National Academy of Sciences

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Highway Research Board

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Walter C. Wagner

Watch for the January Issue

I.E.S. will be 50 years old in January 1956. In celebration of this, ILLUMINATING ENGINEERING is presenting a very special issue in January. Watch for your copy.

MAKING NEWS!

ease Sighted Executive

interview with
es Executive of
ier Company, it
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three years.
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more architects
specifying Ad-
clusively."

ıe Of Ballasts rom Advance hicago

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lighting indus
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four-watt to bal-
5-watt hot cathode
5-watt 96 inch T-12
limline.

ance Exclusives allast Quality

lighting engineers
contractors are prov-
dvance Transformer
llast quality is the
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on an exclusive basis
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more contractors are
that the "specs" in-
nce Transformer Co.
their own and their
protection.
gnificant tribute to the
y of Advance ballasts"
Ben Wolan, in charge
tern sales.

grity Important In ast Manufacture

the use of sound and
e engineering develop-
ghest quality materials

Many types of ballasts have been created to accommodate circuits for one purpose or another with Advance Transformer Company engineers contributing their share of the "know how" to the general knowledge of practices in the field.

Steady Sales Increase Sighted By Advance Executive

In an exclusive interview with J. C. Hamilton, Sales Executive of Advance Transformer Company, it was revealed that sales of Advance ballasts have shown a steady increase in the last three years.
ts have become recog-
quality product in the
lighting field," he said,
and more architects
specifying Ad-
usively."

this new Adv
Company ballast will lik
w "First" in the fluorescent
ting industry.
Mr. Max Orr, vice president in charge of sales, stated, "This new ballast will offer the lighting fixture manufacturer, architect, lighting engineer and general lighting

Engineers Announce Revolutionary Design For Fluorescent Lamp Ballasts

With the announcement of t
new BRQ 2-S-110 ballast for
96-T-12 lamp at 800 ma. in a Ra
Start design, an entirely new c
cept in the field of fluoresc
lighti may be in prospect. All
ing approximately a 30% re
in size, this ballast immedi
brings the fixture manufact
a new latitude for housing
ventilation, both more efficient
less costly in the final pricin
fixtures. Approximately
weight is also a
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iciency
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ballast
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princi
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the high standards maint
the "Certified Ballast
turers.

Mr. Lou Duman, Pres
Advance Transformer C
announced the perfection
duction of this new and
advanced ballast which w
immediate production.

"Ever conscious of to
consistent with price,"
"our engineers design
to assure the maximum
able service."

Increased efficiency
effected with the new
2-S-110 Rapid Start
Ballast. This is accomp
radically new design
system of assembly
wholly by Advance
Company engineers.
ceded to add stability
life to the performance
last. Optimum effectiv
obtained without elim
vital materials.

NOW! 96T12
CATALOG # BRQ 2-S-110
RAPID START FLUORESCENT LAMP BALLAST

Smaller — approx. 30% REDUCTION
Lighter Weight — approx. 28% REDUCTION
More Efficient — approx. 30% INCREASE

lighter weight and therefore more
economical ballast which will de-

More Efficiency In New BRQ 2-S-110 Advance Ballast

ADVANCE TRANSFORMER CO.

Cable Address "ADTRANS"
2950 N. WESTERN AVENUE
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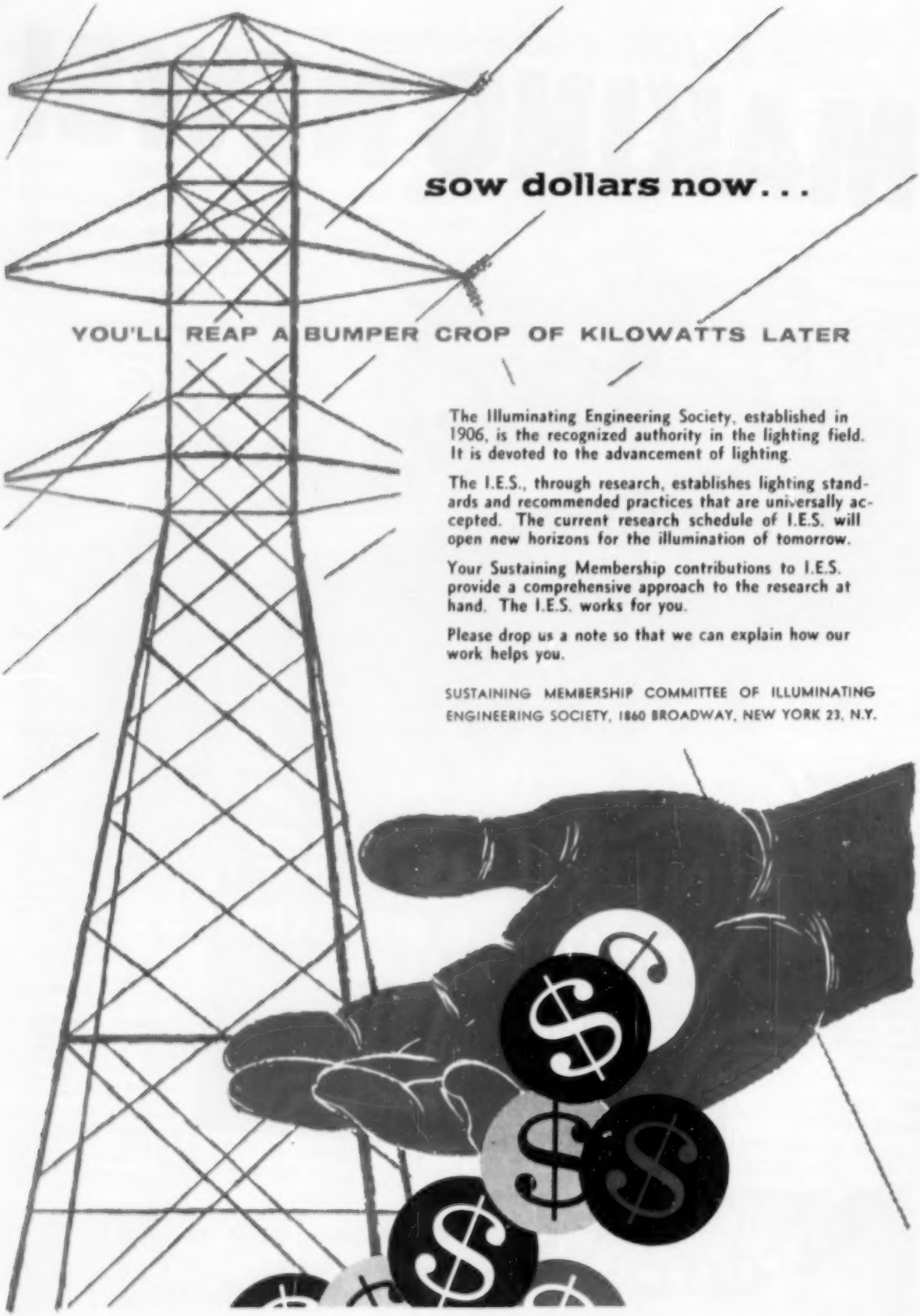

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YOU'LL REAP A BUMPER CROP OF KILOWATTS LATER

The Illuminating Engineering Society, established in 1906, is the recognized authority in the lighting field. It is devoted to the advancement of lighting.

The I.E.S., through research, establishes lighting standards and recommended practices that are universally accepted. The current research schedule of I.E.S. will open new horizons for the illumination of tomorrow.

Your Sustaining Membership contributions to I.E.S. provide a comprehensive approach to the research at hand. The I.E.S. works for you.

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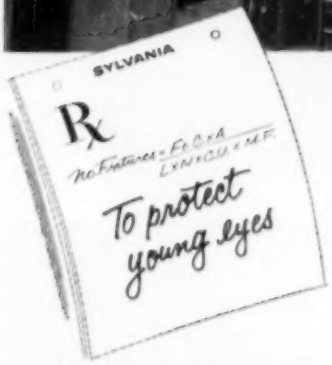
SUSTAINING MEMBERSHIP COMMITTEE OF ILLUMINATING ENGINEERING SOCIETY, 1860 BROADWAY, NEW YORK 23, N.Y.

Sylvania CP-242 Trimline fixtures bring balanced brightness, minimum glare to the kindergarten room of the new Bowen School, Newton, Mass.



NEEDED: A true "Luminous Environment" with balanced lighting

PRESCRIPTION: Sylvania CP-242 Trimline Fixtures

A high over-all quality of illumination in every room (far more than mere foot-candle level) was the order of the day when the city of Newton, Mass., built its modern Bowen School. *Authorities insisted on a true "luminous environment."*

Noted school architect Louis W. Ross of Boston specified high-reflectance ceilings, walls, floors and furnishings for every classroom; light-green chalkboards; combination fenestrations of prismatic directional glass blocks with natural clear glass strips below; and 2 continuous rows of Sylvania CP-242 Trimline fluorescent fixtures with all-plastic, low-brightness shielding (separate switch control for each row).

Result: Equalized lighting level in every classroom location . . . adequate illumination level for all students . . . with relative freedom from glare and over-brightness at any point.

Improved seeing and reading conditions have led to better reading and study habits. What's more—the CP-242 fixtures require maintenance only twice a year, during Christmas and Summer vacations.

This is only one of many lighting "prescriptions" that could be compounded for your needs with Sylvania's full line of school fixtures. Have the Sylvania lighting specialist in your area drop in for a consultation or group meeting at any time—he is a qualified expert in all phases of school lighting.

SEND THE COUPON FOR FREE INFORMATIVE BOOKLET

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Dept. M 30, One 48th Street, Wheeling, West Virginia

- ☐ Please send me your free informative booklet, "Some Whys and Hows of Modern School Lighting."
- ☐ Have a Sylvania lighting specialist call on me.

Name_____ Title_____

Organization_____

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City_____ Zone____ State_____

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Lighting • Radio • Electronics • Television • Atomic Energy

Chicago's Grant Park Underground Garage uses Corning flat and bent Alba-Lite lightingware. Alba-Lite comes in a variety of bends to provide design flexibility. Flat Alba-Lite panels are available in three patterns offering true light source transmission, exceptional brightness control by diffusion, high fixture efficiency, permanence and low upkeep cost.

Owner—Chicago Park District
Consulting Engineers—Ralph H. Burke, Inc., Chicago, Ill.
General Contractor—Electrical work installed by White City Electric Company and J. Livingston and Co., under John Griffith & Son Construction Co., all of Chicago, Ill.
Fixture Manufacturer—Solar Light Manufacturing Company, Chicago, Ill.

Safe, glare-free illumination

for world's largest underground garage

No more circling weary blocks looking for a place to park in Chicago's busy Grant Park area.

Now you swing your car off the street down a ramp to the new Grant Park Underground Garage. There's space there for 2359 cars in 787,000 square feet of floor space.

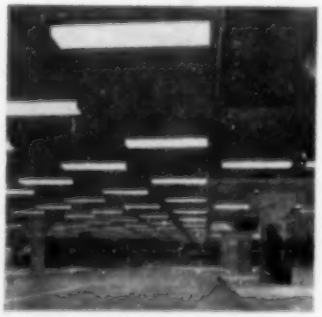
Lighting in this garage, wherein 90% of the cars are self-parkers, must provide for quick adjustment from natural to artificial illumination. "Avenues" must be bright—but free of accident-causing glare and shadows. Walkways must be safe for pedestrians on their way to and from their cars.

High efficiency

Corning Alba-Lite lightingware was selected because it meets all of the requirements for safe lighting established by the Chicago Park District. Alba-Lite is a translucent opal glass. It transmits 60-65% of the light and diffusely reflects 25-30% for an efficiency of greater than 90%. And Alba-Lite transmits the true color of the light source.

In this area where discoloration of lightingware by exhaust fumes could be an expensive maintenance item, easy-to-clean Alba-Lite again proves a wise choice. Nor will time ever dim Alba-Lite's sparkling appearance.

For additional information about Alba-Lite and other Corning-engineered lightingware—louvering, diffusing, and prismatic—use the form below.



Connected lighting load, approximately 450 KW. Maintained lighting level, main thoroughfares, 22 foot-candles. Maintained lighting levels, distribution center, 30 foot-candles. Average parking area illumination, 10 foot-candles.

CORNING GLASS WORKS
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Corning means research in Glass

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Please send me a copy of the "Architects and Engineers Handbook of Lighting Glassware."

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Fluorescent Fixtures of California

the symbol All-Brite LIGHT OF THE WEST of progress in

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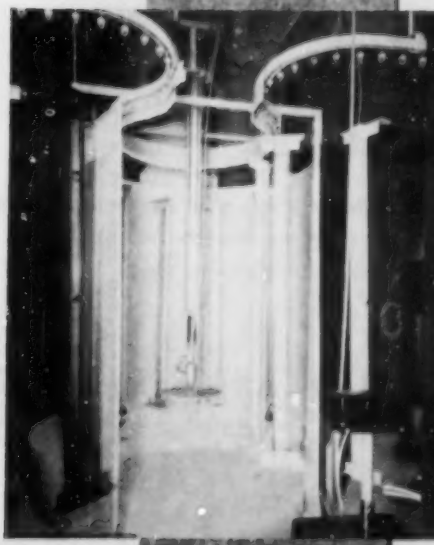

New Electrostatic Paint Process—first of its kind in the lighting industry—insures highest quality finish for all painted All-Brite parts.

ask your contractor about Certified Lighting

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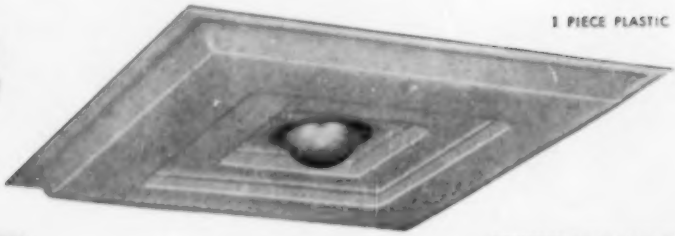
THREE PLANTS TO SERVE THE WEST

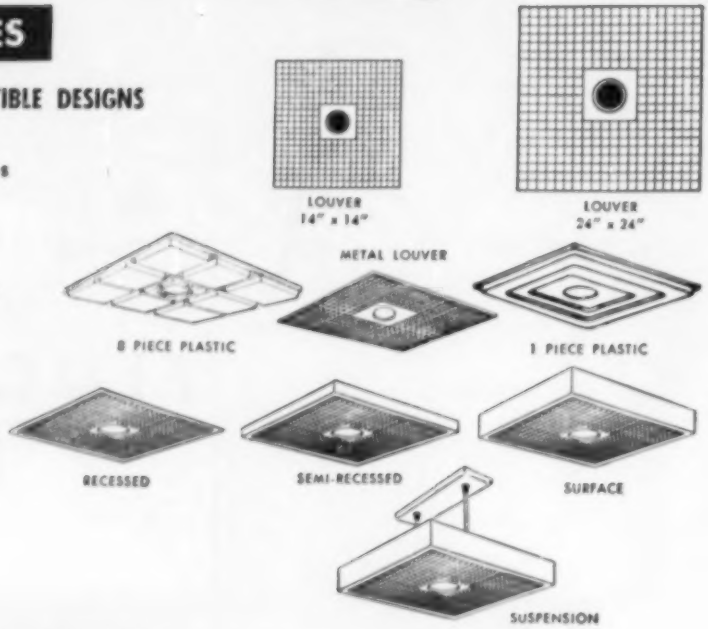
ONLY Skylike

HAS ALL THESE EXTRA



MECHANICAL FEATURES

- **TWO FIXTURE SIZES IN COMPATIBLE DESIGNS**
  - 24" Square Skylike 50 Series
  - 14" Square Jr. Skylike 70 Series
- **THREE TYPES OF DIFFUSERS**
  - Metal eggcrate louver
  - Eight panelled plastic diffuser
  - One piece plastic diffuser
- **FOUR TYPES OF MOUNTINGS**
  - Recessed
  - Semi-Recessed
  - Surface Mounted
  - Suspension Mounted
- **FIVE LAMP SIZES**
  - 100 to 500 Watts
- **CHOICE OF WIRED OR PRE-WIRED ASSEMBLIES**



EXCLUSIVE DESIGN FEATURES

- One piece die formed reflectors—contoured to give highest utilization of silvered bowl lamp output.
- Projection welded louver assembly—sturdiest louver made in the incandescent equipment field.
- Simple low cost accessories to adapt Skylike units to any ceiling construction.

Skylike THE MODULAR SILVERED BOWL INCANDESCENT UNIT...

Designed and made by the originators of silvered bowl luminaires—the firm that has brought silvered bowl lighting to its present state of perfection and efficiency.

MORE THAN ¼ MILLION INSTALLATIONS IS "PROOF POSITIVE" OF SKYLIKE QUALITY

SKYLIKE LIGHTING, INC.

A SILVRAY ASSOCIATED COMPANY

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Before you specify or buy

Get ALL the facts

Whether you're planning a lighting layout for schools, office buildings, stores or residences it will pay you to get the true facts of the "Skylike Story." Installation, efficiency, maintenance and cost data—yours for the asking. Send request to our Bound Brook Office.

GREAT HALL—COLLEGE OF THE CITY OF NEW YORK
WILLIAM H. BYRNE, P.E., CONSULTING ENGINEER

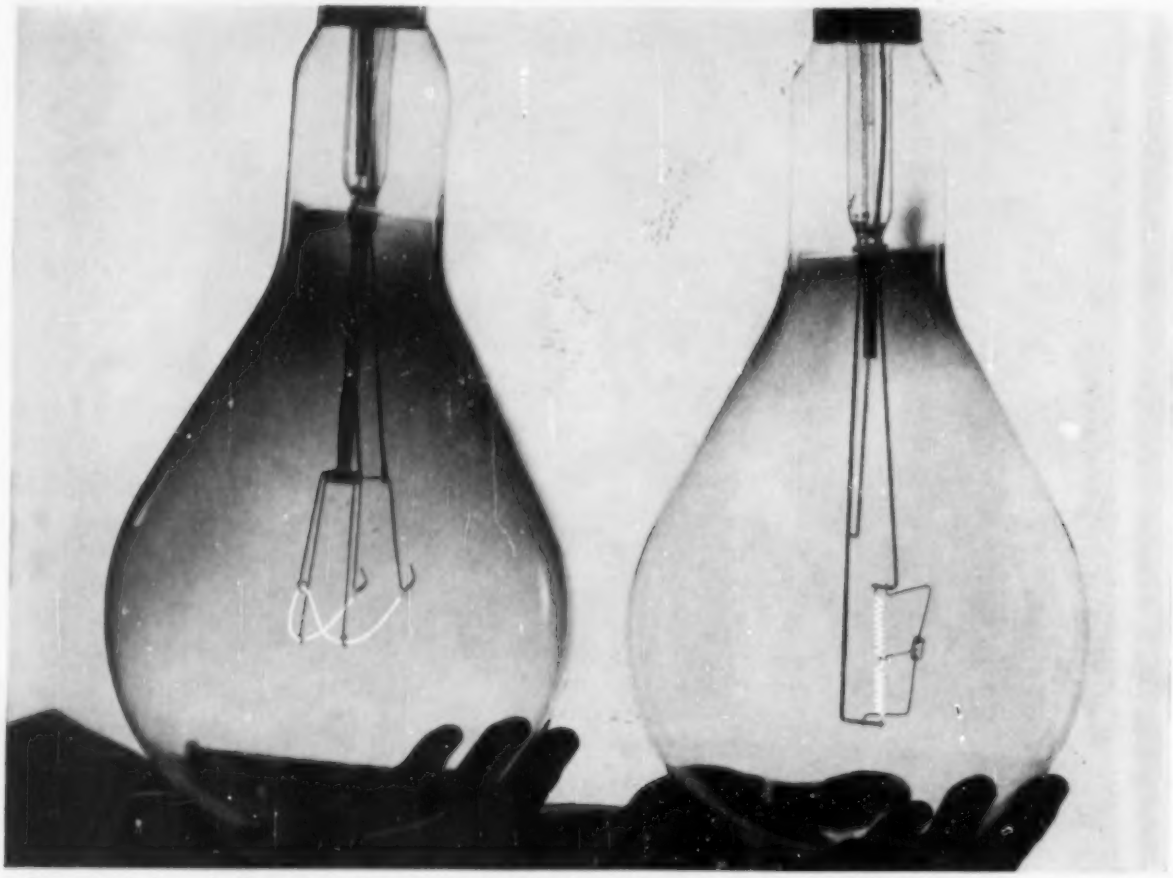
FROM 3.5 TO 35 FOOT-CANDLES

The Rambusch flair for doing architectural lighting without doing architectural violence is exemplified in this installation • Originally the installation consisted of two rows of lanternlike fixtures with amber glass giving three and one-half (3½) foot-candles of light • Due to the 14" thick tile ceiling a normal downlight installation was impractical hence special fixtures were designed and hung just below the ceiling. Each of these houses four (4) 1000-Watt Downlites resulting in a uniform level of thirty five (35) foot-candles discreetly covering the floor • There are 100 Rambusch lighting representatives throughout the country—one of them is near you and anxious to serve you.

RAMBUSCH DESIGNERS • MANUFACTURERS
40 WEST 13th STREET, NEW YORK 11, N. Y.

Announcing: New G-E Bonus Line of lamps, incorporating the most important development in light bulb filaments since 1913!

New G-E discovery uses revolutionary stand-up filament to give you 15% more light from a bulb



Compare standard crosswise filament, left, with new G-E stand-up filament, in bulb on right. Note reduction in bulb blackening after same hours of use.

Promises America a Yearly Light Bonus of Over $100,000,000

General Electric announces the most important development in light bulb filaments in 42 years—a filament that stands on end. It gives up to 15% more light at no increase in cost to you for current consumed.

The 750 and 1000 watt Bonus Line G-E Lamps are available now, at same list price. Other sizes from 60 to 500 watts are being redesigned to use the new stand-up filament

FOUR YEARS OF RESEARCH

Four years of intensive research were required to solve the technical problems involved in changing from the usual crosswise position to a vertical position.

The light gain achieved by the new stand-up positioning is a minimum of 6%. The new positioning makes it practical for the first time also to use a specially designed coiled-coil filament in bulbs of 300 watts and over. In these larger bulbs, the two improvements combine to bring the light increase to 15% during the life of the bulb—*extra light worth the entire purchase price of the bulb itself!*

LIGHT INCREASED, BLACKENING REDUCED

The new stand-up filament increases light output in two ways.

First, the hotter a filament burns the more light it gives, and the vertical position allows the filament to burn hotter without burning out any sooner.

Second, the effect of bulb blackening on light output is cut to a minimum. Blackening is concentrated in the stem of the bulb when it burns base up, or in a small spot at the opposite end when burned base down. Safely out of the way in either case.

$100,000,000 LIGHT BONUS

G-E incandescent bulbs using the new filament are called the G-E Bonus Line. The value of the light bonus they will ultimately deliver is estimated at over $100,000,000 a year. For more information write General Electric Large Lamp Department, Nela Park, Cleveland 12, O.

Progress Is Our Most Important Product

GENERAL ELECTRIC

(Continued from page 17A)

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(Continued on page 36A)

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All territories, to call on wholesale trade and architects with a complete line of fluorescent, slimline and new plexiglass 2 x 2 and 4 x 4 squares, etc. Excellent opportunity for high caliber men to make money. Liberal commission, protected territory. Write giving full information on lines carried and territory covered. Mercury Electric Co., 207 S. 13th Ave., Mt. Vernon, N. Y.

DRAFTSMAN-DESIGNER-ENGINEER

Nationally known Chicago manufacturer fluorescent lighting has opening for talented Draftsman-Designer-Engineer for lighting fixtures. Engineering Degree desirable but not necessary.
Excellent opportunity for advancement. Write giving complete experience, salary desired and best time for interview. Address Box 256, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.

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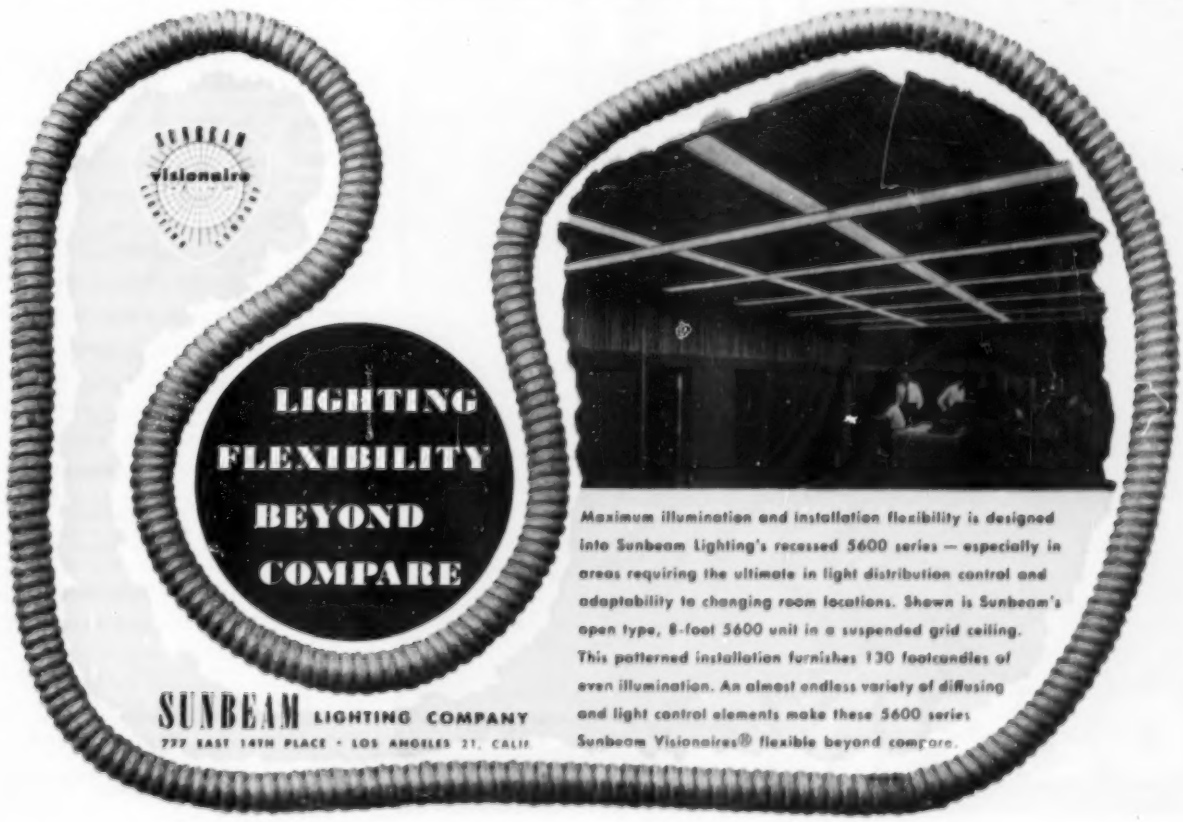
Seek two experienced commission salesmen with ambition, drive, and yen to make more money. Should be well-versed in all phases of the lighting field . . . engineering or technical background helpful. Must be calling on architects, engineers, distributors and contractors . . . in the MINNESOTA, NORTH & SOUTH DAKOTA, or the UPPER NEW YORK STATE territories.
We are a large, progressive and growing manufacturer of complete lines of competitively priced lighting for all applications. Our quality and service are the envy of the industry. These territories are now active and profitable . . . we are being specified and displayed . . . our men get powerful promotional backing. These openings are due to a long-range expansion of our facilities, lines and promotional programs. Send full details to Box 257, Publications Office, Illuminating Engineering Society, 1860 Broadway, New York 23, N.Y.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SUNBEAM LIGHTING COMPANY
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Maximum illumination and installation flexibility is designed into Sunbeam Lighting's recessed 5600 series — especially in areas requiring the ultimate in light distribution control and adaptability to changing room locations. Shown is Sunbeam's open type, 8-foot 5600 unit in a suspended grid ceiling. This patterned installation furnishes 130 footcandles of even illumination. An almost endless variety of diffusing and light control elements make these 5600 series Sunbeam Visionaires® flexible beyond compare.

". . . was tested in our laboratories . . . we are setting up quality control for tools and procedures to assist you in maintaining the same good quality. . . ."
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Maximum width 54", length 76" • clear transparent and colors
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Long development and experimental work have resulted in superb quality acrylic sheets. Local manufacturers say "finest extruded sheets available anywhere . . . easy forming and machining." Copy of DuPont endorsement letter on request.
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KENILWORTH, N. J.
PIONEERS IN MODERN PLASTICS FOR OVER 30 YEARS

(Continued from page 35A)

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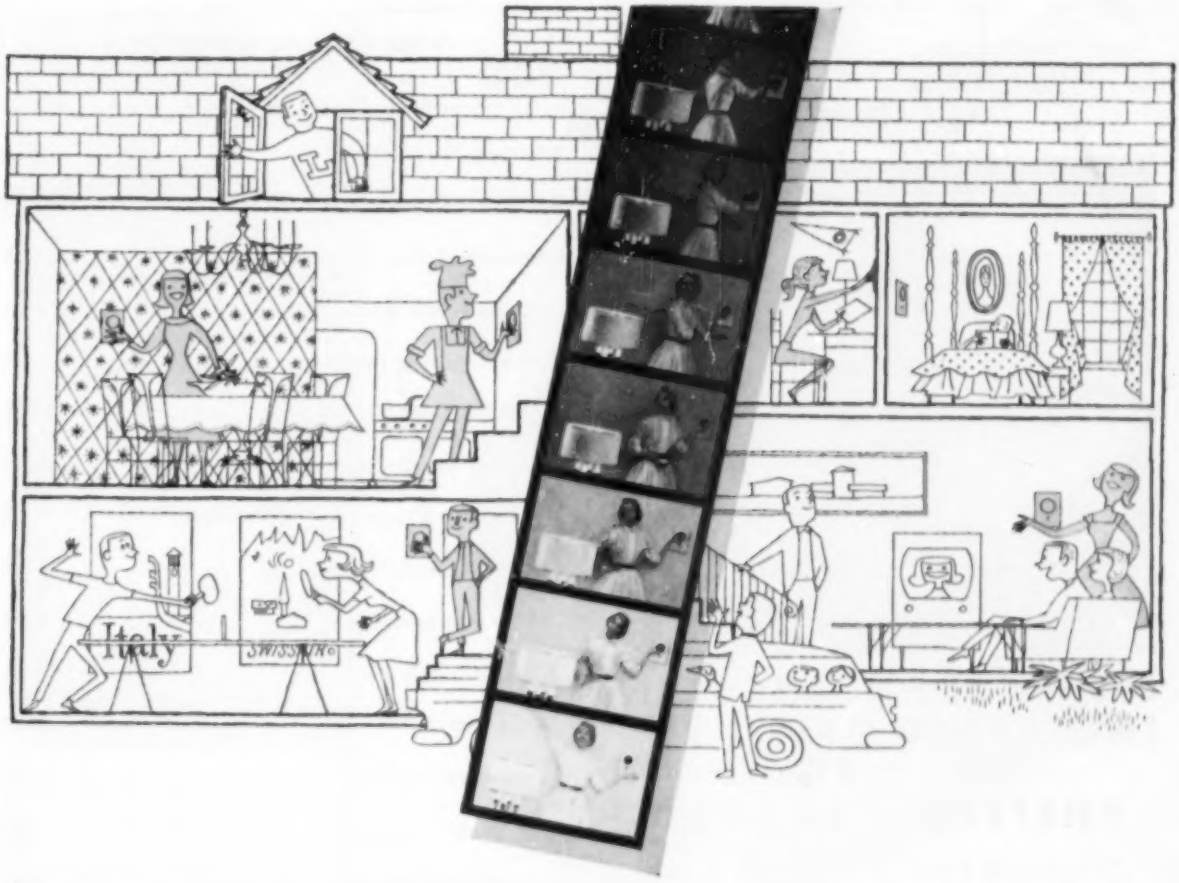

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Here at last—for homes, hotels, churches, schools, restaurants, offices, stores—is a light control that makes sense. A light control that produces at the turn of a dial, any level of light from dark to full-bright, **the perfect level of light for every occasion, every activity, every effect.** New LUXTROL Light Control frees your layouts once and for all from the limitations of on-off lighting. It puts in your hands a whole new dimension in modern, functional design. LUXTROL is **not a rheostat.** It is a soundly engineered autotransformer type unit. It has both fuse and thermal overload protection. It operates smoothly, silently, safely, is approved by Underwriters' Laboratories. **No complex wiring required:** LUXTROL replaces ordinary on-off switches, is just as easy to incorporate in your plans. What's more, LUXTROL controls not only incandescent lighting but fluorescent and cold-cathode, too. And it's priced surprisingly low. **Arrange a LUXTROL demonstration.** We'll send you the name of the nearest distributor plus full design data, just send in the coupon.

New **LUXTROL** light control

THE SUPERIOR ELECTRIC COMPANY
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Please send me the name of the nearest distributor and full design data on new LUXTROL Light Control.

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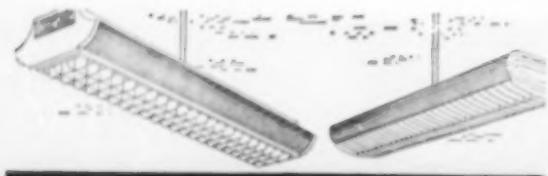
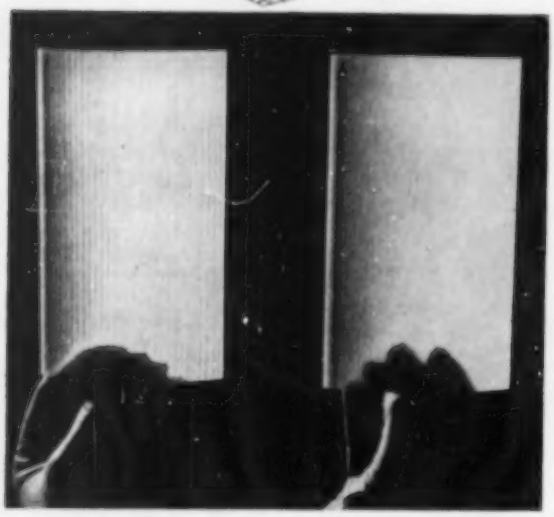
Watch for our mobile display, "a mansion on wheels," with the latest on lighting in actual room settings.





LIGHT TRANSMISSION INCREASED UP TO 50% BY NEW SHEFFIELD SHIELDS

You can now increase the efficiency of and add beauty to your fluorescent fixtures with Sheffield's new DG-70 grade plastic diffusers.

Made of a polystyrene formulation devised by Sheffield engineers, the new shields transmit up to 50% more light than shields made of conventional polystyrene. Light transmission values up to 70% are possible. Shields made of DG-70 also have exceptional hiding power, good impact strength and a fine surface finish.

DG-70 is another example of progressive engineering at Sheffield Plastics — engineering devoted to providing you with top quality, rigid extrusions incorporating the latest technical advances.

For more information about DG-70 diffusers or a quotation on a rigid extrusion, write to Sheffield Plastics Inc., Dept. 151-3B, Sheffield, Mass.

Precision Engineered Rigid Plastic Extrusions

SHEFFIELD PLASTICS
INC.
SHEFFIELD, MASS.

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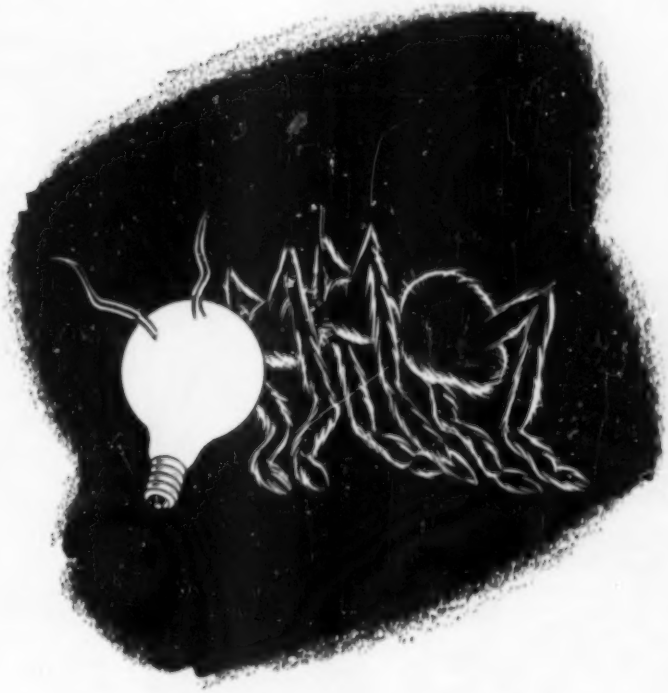

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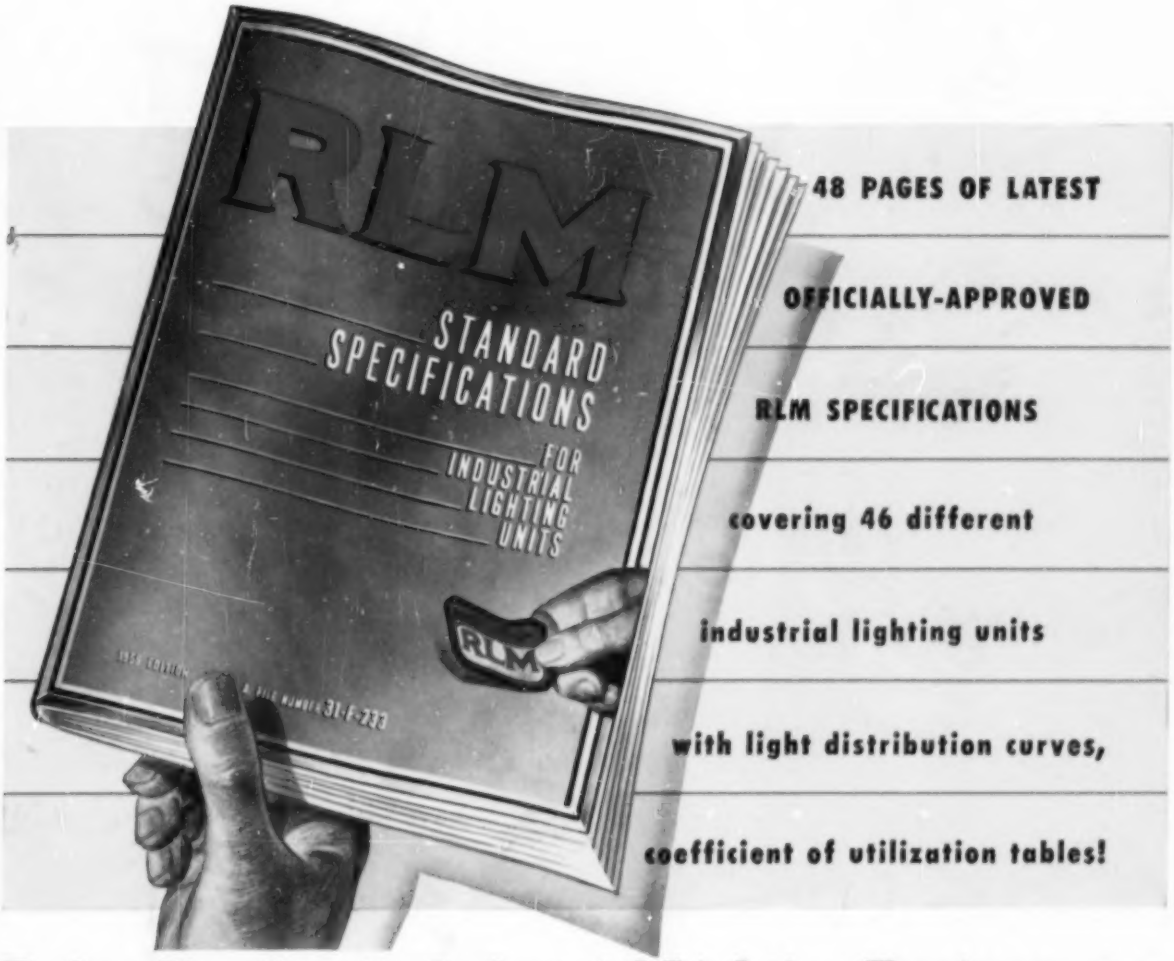

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